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# Excess outfitting materials in Ship Construction Navy (SCN)--shipbuilding programs: an analysis of the initial allowance development process.

Feierabend, Richard H.

# NAVAL POSTGRADUATE SCHOOL
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SHIP CONSTRUCTION NAVY (SCN)
SHIPBUILDING PROGRAMS:
AN ANALYSIS OF THE INITIAL ALLOWANCE
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by

Richard H. Feierabend

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# Excess Outfitting Materials in Ship Construction Navy (SCN) Shipbuilding Programs: An Analysis of the Initial Allowance Development Process

by

Richard H. Feierabend
Lieutenant Commander, Supply Corps, United States Navy
B.A., Hamline University, 1975

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1987

# ABSTRACT

This thesis investigates the accumulation of excess outfitting material during a ship's initial supply support development process. The SCN allowance development process is discussed in general. The Integrated Stock Number Sequence Listing (ISNSL) , the primary supporting sub-system for Ship Construction Navy (SCN) shipbuilding program allowance development, is reviewed. Analyses of ISNSL statistics from FFG-7 and SSBN-726 Class shipbuilding programs are conducted. The affects of configuration changes and adjustments to item management information, particularly the Best Replacement Factor (BRF) on excess outfitting materials is reviewed.

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| APL | Allowance Parts List |
| BRF | Best Replacement Factor |
| CF | Contractor Furnished |
| CFE | Contractor Furnished Equipment |
| CFM | Contractor Furnished Material |
| CNO | Chief of Naval Operations |
| COSAL | Coordinated Shipboard Allowance List |
| DLA | Defense Logistics Agency |
| DOD | Department of Defense |
| DOP | Designated Overhaul Point |
| FILL | Fleet Issue Load List |
| FLSIP | Fleet Logistics Support Improvement Program |
| FMSO | Fleet Material Support Operation |
| FOMIS | Fitting Out Management Information System |
| GF | Government Furnished |
| GFE | Government Furnished Equipment |
| GFM | Government Furnished Material |
| HSC | Hardware Systems Command |
| ICP | Inventory Control Point |
| ILS | Integrated Logistic Support |
| ISEA | In Service Engineering Activity |
| ISNSL | Integrated Stock Number Sequence List |
| LSA | Logistics Support Analysis |

| | |
|---|---|
| MDF | Maintenance Data File |
| MIL-STD | Military Standard |
| MLSF | Mobile Logistics Support Force |
| NAVSEA | Naval Sea Systems Command |
| NAVSUP | Naval Supply System Command |
| NIIN | National Item Identification Number |
| OSI | Operating Space Item |
| PECI | Preliminary Equipment Configuration Index |
| PESA | Provisioning Engineering Support Activity |
| PPS | Provisioning Performance Schedule |
| PRS | Provisioning Requirements Statement |
| PSI | Program Support Interest File |
| PSICP | Program Support Inventory Control Point |
| PTD | Provisioning Technical Documentation |
| SCN | Ship Construction Navy |
| SECNAV | Secretary of the Navy |
| SHAPM | Ship Acquisition Project Manager |
| SIMSL | Shore Intermediate Maintenance Stock List |
| SM&R | Source, Maintenance and Recoverability Code |
| SRASL | Selected Restricted Availability Stock List |
| SRI | Store Room Item |
| TARSLL | Tender and Repair Ship Load List |
| TRF | Technical Replacement Factor |
| UICP | Uniform Inventory Control Point |
| WSF | Weapon System File |

# I. INTRODUCTION

## A. BACKGROUND

The 1980's have seen an unprecedented peacetime acquisition of military hardware in the Department of Defense (DOD). For the Navy this growth has included an ambitious and aggressive assortment of ship, aircraft and weapon systems acquisition programs. The purpose of these programs has largely been to return the Navy to a 600 ship force and equip those ships with the most capable weaponry and support systems available from current technology.

The business of buying and fielding naval weapons systems, ships or aircraft is complex. The time horizons of major system procurements are long; the process is technically challenging and administratively cumbersome; the decision making is complex; the goals conflicting; and the environments; political, military, and economic, are constantly changing.

Within the arena of major military acquisitions the Navy's Hardware Systems Commands (HSCs) have central responsibility for major hardware acquisition and program management. The HSC is responsible for coordination of the myriad of activities associated with the procurement and delivery of military hardware to the operating forces. Included in the HSC's responsibilities is the planning and

implementation of Integrated Logistic Support (ILS) systems. These ILS systems provide maintenance and logistic support for equipment throughout the systems life cycle.

A weapons system ILS plan includes many elements. Among them are; configuration management, maintenance planning, training, technical documentation and repair and spare parts support. The development and implementation of the ILS plan by the HSC requires the assistance and coordination of a number of support activities including the Program Support Inventory Control Point (PSICP). It is the Inventory Control Point's responsibility to develop the spare and repair part allowance lists, buy supply system and allowance list material and maintain worldwide repair part inventories to support equipment.

The acquisition strategies and policies used by the Navy to procure major equipments and their associated repair parts have received increased attention and criticism in recent years. This criticism has identified many problems in the way the DOD and the Navy buy equipment, services, spares and repair parts. In response to these problems a variety of programs and policy changes have been implemented to improve the manner in which the armed services buy their equipment and support material.

Within an environment of increased demand for Navy hardware, accelerated acquisition programs, and skepticism regarding the effectiveness and efficiency of military

procurement and inventory management practices the HSC and supporting activities must field new weapon systems, ships and aircraft in a timely and effective manner.

## B. OBJECTIVES

Recent Ship Construction Navy (SCN) shipbuilding programs (including the FFG-7, SSN-688, and CG-47 classes) have experienced an increasing accumulation of excess outfitting materials resulting from the allowance development process. The quantity of excess material on hand is difficult to estimate, in part because all ship construction program managers handle excess outfitting materials differently. It has been estimated that between 10 and 20 million dollars of residual assets are generated annually among shipbuilding programs. Although these figures seem unusually high, significant excesses do result from current outfitting procedures. [Ref. 1]

The FFG-7 Shipbuilding program has centralized the inventory control of it's residual assets. In July 1986 the FFG-7 program had roughly 14,000 line items valued at 7 million dollars of excess material on hand in it's warehouse [Ref. 2] The FFG-7 program has attempted to manage and use it's residual assets effectively. However, the cost of maintaining warehousing services is high (currently about $200,000 per year).

Other shipbuilding programs (SSN-688, CG-47, CVN) have similar residual asset difficulties. The sum of all shipbuilding program excess outfitting material suggests that substantial benefits are possible from a review and modification of the allowance development and computation programs from which residual assets emerge.

The Navy's method of developing initial allowance lists and outfitting newly constructed ships is based on the Incremental Stock Number Sequence List (ISNSL) process. The ISNSL process is considered by NAVSEA and NAVSUP to be a major cause of excess or residual outfitting material. [Ref. 1]

The ISNSL program is part of the Uniform Inventory Control Point (UICP) system executed by the Ships Parts Control Center (SPCC). Broadly, UICP is a large set of automated inventory and financial management programs designed to determine supply support requirements and manage the Navy's supply system. The ISNSL process embodies the allowance development, outfitting and logistics policies of the DOD, SECNAV, CNO and the Hardware Systems Commands.

Numerous point papers regarding SCN excess outfitting material have been written for the Navy's logistics community since 1984. Many of these papers have served the purpose of identifying problems with current SCN outfitting procedures and alerting logistics managers in the Navy of the problems. The following discussion outlines current

efforts to research and correct the accumulation of residual assets during initial ship outfitting.

### 1. NAVSEA Incremental Stock Number Sequence List Task Force

In September 1985 the Naval Sea Systems Command convened a Task Force to study the ISNSL's affects on excess outfitting material. The Task Force was formed in response to several point papers regarding ISNSL churn. ISNSL churn can be simply defined as spares/repair parts being added to allowance on an early ISNSL and being disallowed on later ISNSLs. ISNSL churn is discussed in detail later. The primary purpose of the initial Task Force meeting was to develop a research agenda on issues that contribute to changes in ISNSL allowance quantities from one listing to the next.

Participation in the initial meeting included representatives from NAVSEA, NAVSUP and SPCC. Task Force topics included discussion of the following; 1) the impact of shifting supplier codes (GF to CF or vice versa) on ISNSL churn, 2) the use and effectiveness of the ISNSL residual assets routine, 3) the effects of re-provisioning on ISNSL churn, 4) the effects of erroneous configuration and configuration changes on ISNSL churn, 5) the effects of BRF updating on ISNSL churn and 6) the administrative costs and burden of processing excessive ISNSL adjustments. [Ref. 2]

Although several action items were assigned as the result of the initial ISNSL Task Force meeting, few have been completed to date. A follow-on meeting has not been convened. It appears that efforts by the Task Force to correct ISNSL churn/excess outfitting material problems have been limited to a forum for problem discussion.

2. Fleet Material Support Office (FMSO) ISNSL Churn Study

In May 1986 the Fleet Material Support Office (FMSO) began the study of ISNSL churn for SPCC and NAVSUP. The FMSO study concentrates on the impact of changes in Best Replacement Factor (BRF) and ship's configuration on ISNSL churn. The study will attempt to identify the causes of ISNSL churn and recommend alternative methods for ISNSL computation and processing. Based on data availability and study methodology, results will be available in May 1987. [Ref. 3]

With concern over Navy inventory management and procurement practices, the primary purpose of this thesis is to review the new construction ship allowance development process, policies and programs. The ISNSL process and the ISNSL products of several FFG-7 and SSBN-726 class ship's will be reviewed in detail in an effort to discover the causes of excess allowance materials accumulated during the SCN allowance development and outfitting period and recommend policy or program modifications.

## C. RESEARCH QUESTION

The primary research in this thesis attempts to identify relationships between excess allowance materials accumulated during the Ship Construction Navy (SCN) outfitting process and the Navy's programs, methods and procedures for determining those allowances. The Uniform Inventory Control Point (UICP) Incremental Stock Number Sequence List (ISNSL) is the primary source of authorized allowance list material for SCN shipbuilding programs.

The ISNSL has been identified as a major cause of outfitting material excesses. [Ref. 1] ISNSL churn is the computation of an item for allowance in an ISNSL on a given date and the subsequent increase or decrease the the item's stockage depth , in the computation of a later ISNSL. The ISNSL relies on data from a number of sources, both internal and external to the UICP system, for the computation of allowance lists. In many ways the ISNSL represents the culmination of a series of processes and steps in the overall allowance development effort.

The computation of the allowance for a single repair part relies on several factors. These factors are determined throughout the allowance development process and considered within the ISNSL program. Therefore, to some degree the source of ISNSL churn lies not within the ISNSL

process itself but rather within the information and sub-processes which proceed it. This research will therefore attempt to identify which factors and portions of the allowance development and ISNSL process contribute the most to the accumulation of excess materials during the SCN outfitting period.

Secondary questions addressed by the research include the following:

1) The ISNSL programs and the allowance development process in general represent an implementation of Department of Defense and Department of the Navy policies on initial secondary item outfitting and allowance development. To what extent do these policies contribute to the problem of accumulated excess outfitting material?

2) The Navy has several ongoing shipbuilding programs. What is the estimated cost or value of the excess materials or "residual assets" as they are sometimes referred to? What is the current method of handling and disposing of these materials?

## D. SCOPE AND LIMITATIONS OF RESEARCH

This thesis is limited to the allowance development process used for shipbuilding programs managed by the Naval Sea Systems Command (NAVSEA). It is further limited to only those programs for which the Navy Ships Parts Control Center

(SPCC) is the Program Support Inventory Control Point (PSICP).

The primary source of data for this thesis was ISNSL summary statistics and reports for FFG-7 and SSBN-726 class shipbuilding programs obtained from the Ships Parts Control Center, Mechanicsburg, PA. A research visit to SPCC permitted data collection and interviews with allowance development personnel and ISNSL system analysts.

## E. RESEARCH APPROACH

The research for Chapter II was confined largely to Navy instructions, directives, and Military Standards pertaining to allowance development procedures. Chapter II provides a broad perspective from which to view the allowance development process and the key issues regarding excess allowance materials. Chapter II sets the stage for an understanding of the data analysis which follows. The research for Chapter IV was based on the ISNSL records of FFG-7 and SSBN-726 class ships. An analysis of this data is performed to isolate those factors which have the greatest impact on ISNSL churn and the excess allowance materials that result. Multiple linear regression, variance analysis and mean comparison statistical tests are the primary tools of this analysis. The regression analysis attempts to describe the relationship between ISNSL churn (the dependent variable) and equipment configuration and Best Replacement

Factor (BRF) adjustments (the independent variables). Variance analysis and mean comparison testing attempt to determine the following:

1) If any difference in ISNSL churn exists between allowance material categories (government furnished, contractor furnished, storeroom items, and operating items).
2) If ISNSL churn is affected by annual Best Replacement Factor (BRF) updating.

# II. THE SHIP CONSTRUCTION NAVY (SCN) ALLOWANCE DEVELOPMENT PROCESS

Chapter I introduced the Navy ship acquisition and allowance development process as a complex system functioning within an equally complex environment. Determining initial levels of spare and repair parts stockage for new weapon systems has far reaching affects on readiness. The intent of that process is to provide the best possible logistic support consistent with DOD and Navy policies and funding limitations. The fact that extensive excess outfitting materials accumulate over the course of Navy shipbuilding programs indicates that the manner in which initial allowances are determined needs review.

The purpose of this chapter is to introduce the major factors in the new construction allowance development process. These factors include:

a. Provisioning

b. New construction allowance development

c. New construction configuration development.

The above activities represent much of the effort in determining the supply support needs of a new ship. These activities are not necessarily sequential. They may be best characterized as iterative, and often parallel in nature. The responsibility for determining shipboard allowances is

divided among several activities. Therefore, the responsibility for completing the above action is equally divided.

It is not intended that the following sections provide a comprehensive discussion of the SCN allowance development process. Rather, this chapter is intended to introduce the concepts necessary to understand and appreciate the complexity of the new construction allowance development process.

## A. PROVISIONING

New equipments are continually being procured by the Navy to upgrade Fleet operational capabilities. These equipments are usually procured by the Hardware Systems Command (HSC) and installed on both new ships and existing fleet units. These new equipments must be supported by the Navy supply system to maintain Fleet readiness. Navy supply support for new hardware is achieved through the provisioning process. The provisioning process is a joint effort involving the equipment contractor, the HSC, the In-Service-Engineering-Activity (ISEA) and the Navy Ships Parts Control Center (SPCC).

Provisioning is a time consuming process. Often the time required to fully provision equipment and attain complete Navy supply system support exceeds the time

required to procure, install, checkout and place a new item of equipment in operation on fleet units.

The provisioning process consists of four major phases. These are:

a. Logistic Support Analysis (LSA) and Provisioning Technical Documentation (PTD) development by the contractor

b. Technical coding of the PTD by the HSC or ISEA

c. Supply management coding, Allowance Parts List development (APL), and wholesale and retail requirements determination by SPCC.

d. Procurement Lead Time (PLT). In the past, PLT has not been considered a phase of the provisioning process. Rather, PLT was viewed as part of the contracting function only. As procurement lead times have generally increased, the need to broaden the perception of the provisioning process and manage both allowance determination and allowance material acquisition was recognized.

For complex weapons systems the full provisioning process frequently exceeds 36 months [Refs. 4,5,6]. Each of the phases is discussed in the following paragraphs.

1. <u>Logistic Support Analysis</u>

A Logistic Support Analysis (LSA) is a logistic and engineering analysis performed on an item of equipment or weapon system as part of the system acquisition and design

process. MIL-STD 1388IA is the reference document for LSA procedures. It develops a structured engineering approach to the design of an affordable, supportable, maintainable and operationally effective population of equipment. The LSA approach recognizes that maintainability and supportability variables are critical factors in weapon system effectiveness and life cycle costs. The largest portion of equipment life cycle costs are associated with maintenance and support of equipment after initial acquisition. Recognizing the impact of maintenance and support requirements on overall equipment life cycle costs, the LSA attempts to influence equipment design to minimize logistic and maintenance support needs and reduce life cycle costs.

Historically, maintenance and support needs were addressed only after hardware engineering requirements were filled. This approach often resulted in a well engineered piece of hardware that wasn't maintainable or supportable. By adopting an equipment design philosophy where logistic support, maintenance, reliability, and other engineering concerns are on equal ground, significant improvements in equipment operational effectiveness can be achieved while reducing life cycle costs.

The purpose of the LSA is to integrate logistic support, maintenance and engineering design considerations in the final hardware design. An LSA is an iterative

analysis process implemented in the earliest phases of the equipment acquisition. It is a systematic procedure for reviewing engineering proposals against support requirements. It performs the tradeoff analysis necessary to arrive at the best equipment design to fulfill operational needs while minimizing support requirements and life cycle costs. [Ref. 7]

2. Provisioning Technical Documentation

Provisioning Technical Documentation (PTD) is descriptive information purchased from the equipment manufacturer. PTD is used by the Navy to develop equipment Allowance Parts Lists (APLs) and to load data into associated UICP files.

PTD takes a variety of forms, based on the complexity of the equipment being provisioned and the contractual requirements of the acquisition. PTD for a simple valve or switch may be limited to a few drawings and a manufacturer's parts list. Major weapons system PTD contains all the documentation necessary to identify each component and piece part contained in the equipment, catalogue each item and assign a Nation Stock Number (NSN) or identify the item to a previously cataloged NSN, determine repairability status and estimated failure rate.

Military Standards 1561B and 13882A (MIL-STD 1561B and MIL-STD 13882A) set forth broad provisioning procedures and technical information requirements. MIL-STD 1561B,

Uniform DOD Provisioning Procedures, describes the terms and conditions governing the Department of Defense equipment provisioning process and delineates the responsibilities of the contractor with regard to provisioning. MIL-STD 1561B is primarily a reference document which forms the baseline for provisioning requirements and procedures.

MIL-STD 13882A, Department of Defense Requirements for a Logistic Support Analysis Record, prescribes the format and preparation instructions for PTD and the definition of all provisioning data elements to support the LSA and the follow-on provisioning effort. MIL-STD 13882A replaced MIL-STD 1552 (Uniform DOD Requirements for Provisioning Technical Documentation) as the source document for PTD content and format with the requirement to perform a Logistic Support Analysis (LSA) on major equipment. [Refs. 8,9]

MIL-STD 1561B and 13882B are used by the Navy to develop a Provisioning Requirements Statement (PRS) and a Provisioning Performance Schedule (PPS) for each major equipment acquisition. The PRS and PPS are contained or referenced within the equipment procurement contract.

In an effort to standardize the provisioning requirements across ship equipment acquisitions, the Naval Sea Systems Command (NAVSEA) developed a standard provisioning reference document for all NAVSEA procurements. The NAVSEA Logistic Support Analysis Provisioning

Requirements for Shipbuilding and Conversion Contracts (NAVSEA TL490-AG-GTP-010) provides the needed guidance on LSA and provisioning procedures and PTD requirements for shipbuilding, conversions and major system contracts. From the NAVSEA standardized document, individual PRS and PPS are prepared for specific shipbuilding or equipment procurement contracts. The NAVSEA PRS standard acts as a "fill in the blanks" menu to assure minimum provisioning procedures and data needs are fulfilled. [Ref. 7]

The importance of provisioning technical documentation extends well beyond it's impact on the initial provisioning process. Provisioning documentation forms the database of technical descriptive information for spare and repair part replenishment during the equipment life cycle.

The technical documentation submitted for initial provisioning is required for cataloging, identification of the Original Equipment Manufacturer (OEM), identification of secondary or substitute manufacturers and other procurement needs. Additionally, emphasis on competition in the buying of spare parts has renewed the interest in adequate PTD. The ability to competitively procure repair parts is often dependent on the extent to which adequate detailed technical information exists which fully describes the item desired. The availability or absence of this technical data is frequently a result of the equipment's initial acquisition

and the PTD requirements spelled out within the acquisition contract. [Ref. 5]

3. Technical Coding

The technical coding phase is the process whereby the Hardware System Commands overlays the PTD with the equipment's maintenance strategy. The equipment maintenance strategy reflects the HSC's desires regarding how the equipment is to be maintained, repaired and supported. The maintenance strategy identifies the level of repair (organizational, intermediate or depot) to be used for each maintenance action and whether the equipment will be primarily supported by piece parts or modules. The maintenance strategy is a major by-product of the LSA and it affects manpower, training, parts support and technical data requirements.

Technical coding is typically performed by an HSC's designated engineering support activity. These activities are known as In-Service Engineering Support Activities (ISEAs). When performing technical coding or other provisioning functions on equipment for which they have technical responsibility, they are referred to as Provisioning Engineering Support Activities (PESAs). Major NAVSEA ISEAs with provisioning functions include:

a. Naval Sea Logistic Support Engineering Activity (Hull, Mechanical and Electrical equipment)

b. Naval Ordnance Station Louisville (NAVSEA Gun Systems)

c. Naval Ships Systems Weapons Engineering Station (NAVSEA Ship Missile Systems)

d. Naval Undersea Systems Center (Antisubmarine Warfare Weapon Systems).

An example of the technical coding performed by the HSC or ISEA/PESA is the assignment of Source, Maintenance and Recoverability Codes (SM&R Codes) and Technical Replacement Factors (TRFs). The SM&R code is a 5 digit alpha-numeric code assigned to each repair part and component within an equipment. The SM&R code is the primary way in which the technical and maintenance factors of the HSC's equipment maintenance strategy are translated into specific supply support guidance. The SM&R code plays an important part in the allowance development process as it identifies items within the capability of the ship to remove and replace. The SM&R code thereby determines the parts which are candidates for onboard allowance.

The TRF is an estimated annual failure or replacement rate which is assigned to new items during the provisioning process. The TRF is based on technical, engineering and logistic judgment and is refined over time with actual usage information. The TRF becomes a Best Replacement Factor (BRF) after an item has been in the supply system long enough to establish a demand pattern. The period of time needed to establish a demand pattern is know as the demand development period. The demand

development period is usually one to two years. The TRF or BRF are important factors in the allowance development process and are more fully discussed in section E. [Ref. 10]

The major questions answered by the technical coding process and embedded within the SM&R and TRF codes are:

a. Should a part be stocked in the Supply System?

b. Who can replace the part?

c. Who can repair the part?

d. Who can authorize the part's disposal?

e. What is the part's estimated failure rate?

f. What is the part's importance to the parent equipment?

g. Is the part required to perform preventative maintenance?

The SM&R code contains four pieces of information. The first two characters within the SM&R code are the source code. The source code indicates how the item is to be obtained. For example, the source code can indicate that the item is stocked within the supply system and should be requisitioned via normal channels, is assembled or manufactured locally from other materials or is ordered as part of a kit.

The next two characters are the maintenance code. The maintenance code indicates if the item is replaceable at the organizational (shipboard), intermediate (tender/SIMA) or depot level. Additionally, the maintenance code

indicates the maintenance level authorized to repair the part or component.

The last character of the SM&R code is the recoverability code. This code identifies the maintenance activity authorized to throw the item away. For repairable components this is usually the depot level. [Ref. 5]

#### 4. Supply Management Coding and Allowance Parts List (APL) Development

In it's simplest terms, provisioning is the function of determining the range and depth of spares and repair parts needed to provide initial supply support for a new or modified equipment. Provisioning is a continuous and iterative process and represents the translation of contractor's technical data and the Hardware Systems Commands maintenance philosophy into equipment supply support in the form of onboard allowances and wholesale system stock. The provisioning process begins at the time a new equipment is identified for Navy use and continues until the equipment is phased out of service. In some sense provisioning includes; developing logistic support policy, stockage levels determination, and the purchasing of spares and repair parts. The concept of provisioning is a dynamic cycle. This cycle is repeated with each new equipment, and with each design change or improvement. Figure 1 illustrates the nature of the provisioning cycle. [Refs. 4,5,11]

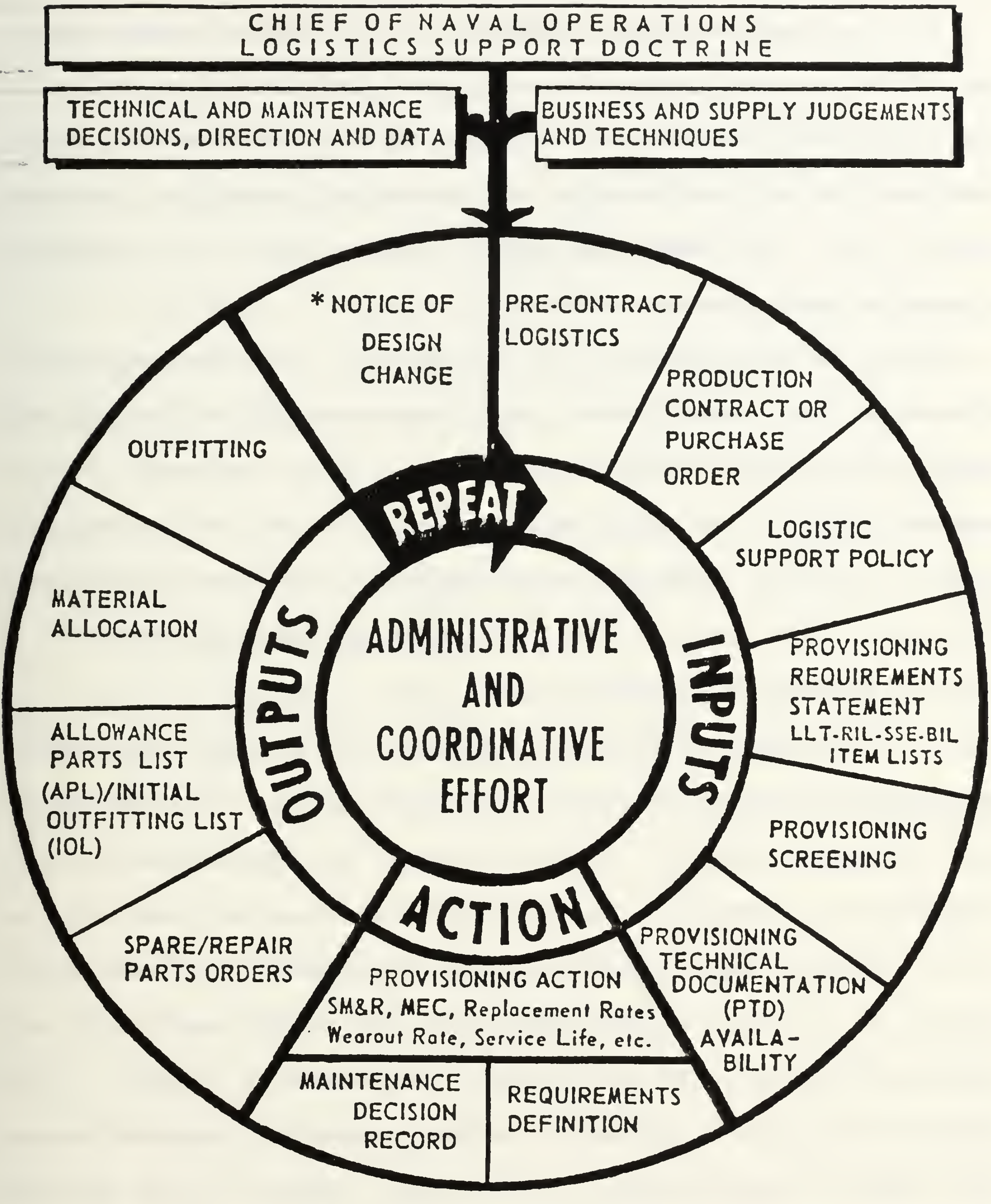


Figure 1. Provisioning Cycle

## B. ALLOWANCE PREPARATION

The purpose of this section is to review the policies and criteria used in developing shipboard allowance levels. The supporting policy for afloat spare and repair part inventory levels will be discussed along with the Navy's methods of implementing policy guidelines in specific allowance determination methods.

Prior to discussing the rules and requirements for allowance list development, an understanding of some major Inventory Control Point (ICP) files is required. The Weapons Systems File (WSF), Master Data File (MDF), Program Support Interest File (PSI) and Technical Reference File are the major files used in the allowance development process.

### 1. Weapons Systems File

The Weapon Systems File is the master equipment configuration data base for all Navy ships. The WSF is a multi-level data base. The upper level of the WSF, commonly referred to as Level A, contains ship configuration data.

The building block of an equipment configuration record is the APL number assigned to each equipment or component during the provisioning process. Level A is basically an index of the installed equipment/components by APL number on each ship. The lower level of the WSF is referred to as Level C. Level C is an index of all repair parts contained within an equipment or component. In summary, WSF Level A is a record of equipment on the ship,

while WSF Level C is a record of repair parts in each item of equipment. Figure 2 shows WSF relationships.

The WSF also contains an intermediate level known as level B. Level B is used primarily for electronic and ordnance equipment to describe subcomponent structures and is on no relevance to this research [Ref. 5]

Shipboard allowance lists cannot be developed without using the configuration information from the WSF. For new construction programs Level "A" is primarily loaded by the shipbuilding supervisory activity or other activities designated by the Project Manager. Level "C" is loaded primarily through the provisioning process.

2. <u>Master Data File</u>

The Master Data File (MDF) is the principle inventory management file for SPCC managed items. The MDF contains roughly 500,000 records and is indexed by National Item Identification Number (NIIN). MDF records are established by the provisioning and cataloging processes. Inventory and procurement data is established and maintained in the MDF by other UICP software applications.

Each record within the MDF has in excess of 300 possible data element entries. These data elements include single entry items (e.g. price, cognizance symbol and replacement factor) and numerous trailers which contain multiple entry, optional or repeating information (e.g., application data, part number cross reference information).

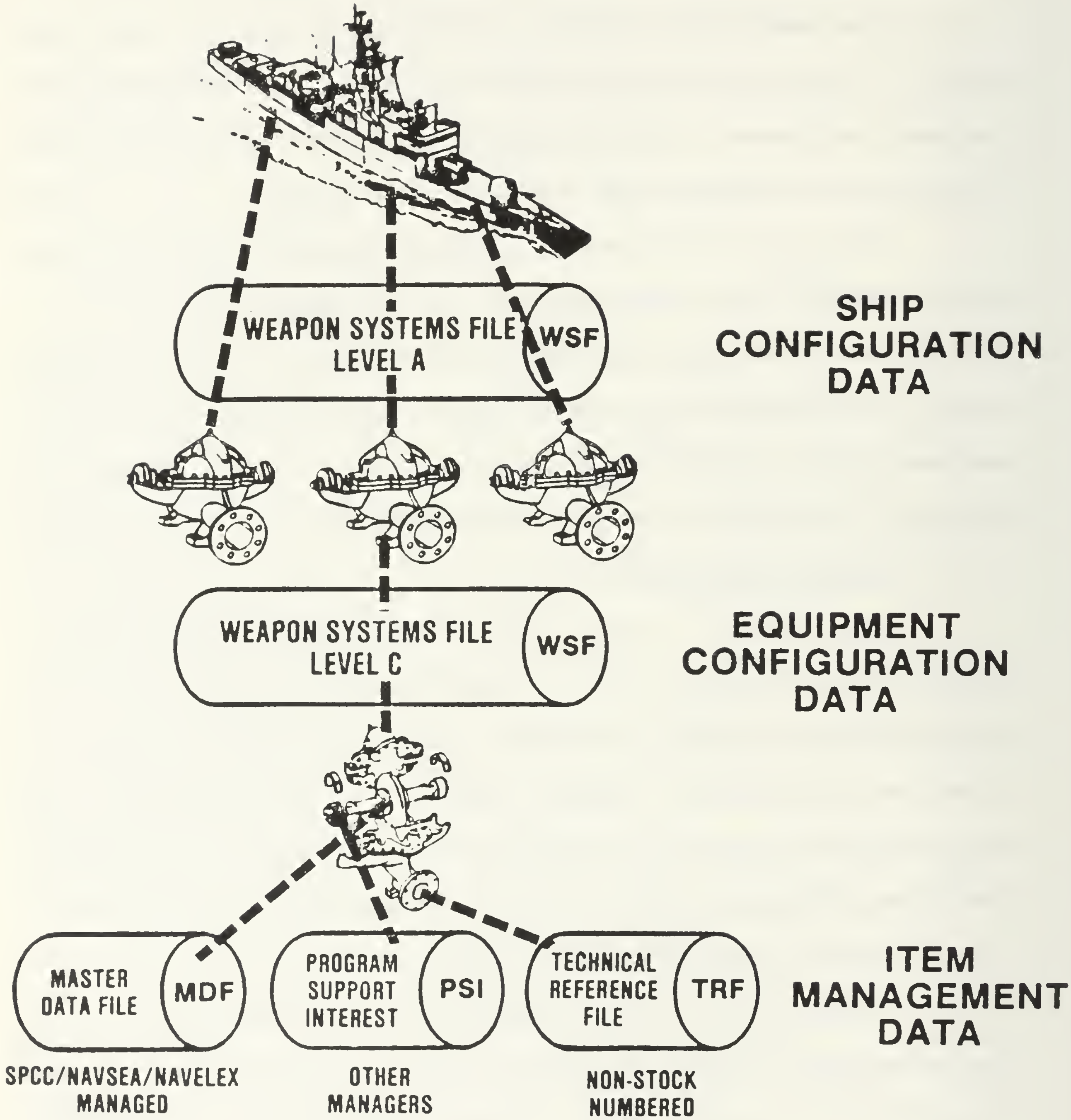


Figure 2. Weapon Systems Structure

The MDF is not a static file. Typically, the MDF experiences from 750,000 to 1.5 million maintenance transactions monthly. This database volatility may have significant effects on the allowance development process.

3. Program Support Interest File

The Program Support Interest File (PSI) is similar to the MDF. The PSI contains records for repair parts installed on ships supported by SPCC which are managed by other Inventory Control Points. The PSI contains virtually the same item management information as the MDF except inventory status information. The PSI is initially loaded during the provisioning process and maintained via a data exchange with the controlling ICP.

4. Technical Reference File

The Technical Reference File is also similar in structure to the MDF and PSI. There are two types of Technical Reference File items; deleted stock numbers and technical reference items. Both of these types of items are significant for maintenance and support. When an ICP decision is made to delete an item from the MDF or PSI, the cataloging and files maintenance process moves the item to the Technical Reference File. The record remains on the file for information purposes, should future demand or applications require the management data associated with the item. This part of the file is know as the inactive Technical Reference File. Inactive items do not appear on

allowance documents and are not candidates for onboard stockage.

The active Technical Reference File contains technical data on maintenance significant items for which there is no predicted demand. Items from the active file can appear on allowance documents as a reminder that they exist and may need to be maintained, but they are not intended for stockage since their failure rates are usually assumed to be zero. [Refs. 5,11]

5. Coordinated Shipboard Allowance List

The Coordinated Shipboard Allowance List (COSAL) implements the Chief of Naval Operations (CNO) shipboard allowance policies. Few processes have more impact on the logistic support of U. S. Navy ships than the COSAL development process. Even with it's recognized importance, the COSAL process remains misunderstood.

Although the Ships Parts Control Center (SPCC) produces and distributes the COSAL, many other activities play key roles in determining the COSAL's quality and value. Hardware Systems Commands (HSCs), Shipyards, Ship Acquisition Project Managers (SHAPMs), Supervisor of Shipbuilding (SUPSHIPS), In-Service-Engineering-Activities (ISEAs) and the Inventory Control Points (ICPs) all have significant roles in the allowance development and COSAL process. [Refs. 4,10]

The COSAL is the primary source of spare and repair parts support for ships. The COSAL is tailored to each ship individually and reflects the support needs of the equipment and components currently installed. It is designed to support the organizational level maintenance. The COSAL allowance is a stockage at the consumer level of inventory.

Levels of inventory and levels of maintenance are separate concepts and need further explanation. Levels of inventory are defined by the Department of Defense as follows:

a. Consumer Level of Inventory: An inventory, regardless of funding source, usually limited in range and depth, held by the final element in an established supply distribution system for the purpose of internal consumption. (Consumer level inventories are developed for use by the activity holding the inventory. They have no resupply or replenishment functions for lower levels of inventory, as there are no lower levels.) [Ref. 5]

b. Intermediate Level of Inventory: An inventory, regardless of funding source, that is required between the consumer and wholesale levels of inventory for support of a defined geographic area or tailored to support a specific set of consumer organizations or activities. [Ref. 5]

c. Wholesale Level of Inventory: An inventory, regardless of funding source, over which an inventory manager at

the national level has asset knowledge and exercises unrestricted asset control to meet worldwide inventory management responsibility. (The primary purpose of wholesale inventories is the replenishment of lower level inventories, both intermediate and consumer.) [Ref. 5]

Levels of maintenance refer to the activity designated to accomplish particular maintenance tasks on an equipment or component. Generally, the more complicated and extensive the maintenance task, the higher the maintenance activity required. For example, routine preventative maintenance is generally performed by organizational (shipboard) personnel. Routine equipment calibration requiring special test equipment is generally done by the intermediate level (tender, repair ship or SIMA). Extensive equipment overhaul is accomplished at the Depot level accomplishment (shipyard, DOP or commercial activity). [Refs. 12,13]

The COSAL is the U. S. Navy's method of determining stockages at consumer level inventories to support afloat organizational level maintenance. Figure 3 shows the levels of inventory, levels of maintenance and the method of determining their support requirements.

The Chief of Naval Operations' policies on shipboard inventories are defined in OPNAVINST 4441.12B. Within 4441.12B the framework and requirements for afloat spare and

repair parts allowances are developed. The fundamental concepts contained within this guidance are:

a. The shipboard allowance document will fully describe installed systems and equipment.

b. Mandatory range and depth of spare and repair parts will be prescribed.

c. The allowance document will be responsive to changes in demand.

| Level of Inventory | | Level of Maintenance | | |
|---|---|---|---|---|
| | | Organizational | Intermediate | Depot |
| Consumer | (Afloat) | COSAL | TARSLL | Shop Stores & SRASL |
| | (Ashore) | COSBAL | SIMSL | |
| Intermediate | | Geographical Operation Support Inventory (GEOSUP)<br>Fleet Issue Load List (FILL) | | |
| Wholesale | | World Wide Support | | Depot Level Provisioning |

Figure 3. Inventory, Maintenance Levels and the Associated Stockage Lists

d. The allowance document will reflect the essentiality of each equipment/component in it's method of computation.

e. The allowance document will provide 90 percent protection against stockout for a 90 day period for demand based items. [Ref. 14]

A discussion of demand based and non-demand based allowance items will be included later.

6. Fleet Logistic Support Improvement Program

With OPNAVINST 4441.12B identifying the fundamental requirements of shipboard allowances the COSAL process and supporting computation methods were developed to satisfy these needs. The Fleet Logistic Support Improvement Program (FLSIP) was developed in response to the policy guidance set forth by CNO. The FLSIP concept determines shipboard allowance levels by considering the following major factors:

a. Ship maintenance capability

b. Total ship equipment configuration and total equipment repair parts population

c. Each repair part's failure rate (commonly referred to as a part's Best Replacement Factor or BRF).

The term FLSIP is also applied to the basic mathematical model used by the FLSIP program. The FLSIP model determined most shipboard allowances during the 1970's and early 1980's.

The straightforward FLSIP model is being phased out by the MODFLSIP model as the primary computational method for shipboard allowances. However, the FLSIP concept forms the basis for current computational methodologies and an understanding of it is useful. The following is a discussion of the basic FLSIP concept and the FLSIP computational model.

The FLSIP concept involves three essential considerations:

a. Replaceability

b. Likelihood of need

c. Importance.

The first consideration, replaceability, means that the ship must have the capability to remove and install a part before that part will be considered for onboard stockage. This consideration is a direct result of the maintenance and support strategy developed by the Hardware Systems Command for the installed equipment and the ship as a whole. This maintenance strategy is applied to each repair part by the technical coding performed during the provisioning process. If the ship doesn't have the trained personnel, special tools/test equipment and technical documentation aboard to remove and install a part, it makes no sense to stock the part. [Ref. 10]

The second element of the FLSIP concept, likelihood of need, involves both economic and storeroom space considerations. Clearly, a ship cannot stock one of everything within it's storerooms. If this were the allowance criteria, Navy ships would have to be twice the size they are to accommodate all their spares, and there would be half as many ships because of the cost of the stocked parts. Because of these physical and economic limitations the replacement rate reflected in an items Best

Replacement Factor (BRF) is a central determinate of onboard allowance. The replacement rate of a part, multiplied by the total number of this part installed onboard, determine the likelihood that a part will be needed. [Ref. 10]

The last FLSIP consideration, importance or military essentiality, involves a judgment regarding the importance of the repair part to the operation of the equipment within which it is installed. If items are not important to the ship's installed equipment or mission then scarce dollars and onboard stowage space should not be invested in them. The concept of importance and mission essentiality was poorly addressed by the basic FLSIP computation model and is the primary reason it is being replaced by a second generation of allowance development algorithms. [Ref. 10]

The FLSIP computation process begins with an examination of all allowance candidate items for a ship. The allowance candidates are determined by extracting the ship's configuration data from the WSF level A and equipment to repair part information from the WSF level C. Each repair part within the ship's maintenance level is then summed with all other identical parts to develop a total ship's allowance candidate list. Only those items authorized to be replaced onboard are selected by the FLSIP process as candidates.

Once the allowance candidate list has been developed, it is passed through the FLSIP demand qualifier

program. The total installed part population on the ship (obtained by multiplying the equipment population by the part population per equipment) is multiplied by the part's Best Replacement Factor (BRF). The resulting quantity is then compared with the "demand based" and "insurance based" item criteria established by CNO policy.

For basic FLSIP, if the expected part usage is greater than or equal to four parts per year, (total ship's population times BRF greater than or equal to 4) the item is then considered demand based. An allowance quantity is computed for each demand based item which provides a 90 percent protection against stockout for a 90 day period.

If the part's usage is less than four per year and both the part and the equipment on which it is installed are coded vital then the candidate item is passed to the insurance items program. Each remaining candidate is then screened to determine if the part's expected usage meets the CNO criteria for insurance stockage. If the candidate item has an expected usage of at least one every four years (population times BRF greater than or equal to 0.25) it is selected under basic FLSIP as an insurance item for onboard stockage.

Unless the remaining candidate items are identified by specific mission, maintenance or safety override codes as required for stockage, they are rejected for onboard stockage. Because the straightforward FLSIP allowance

computation technique provides onboard allowances for virtually all items with total shipwide usage of one every four years (population times BRF greater than or equal to 0.25) it is commonly known as the .25 FLSIP computation method. [Refs. 5,10]

The shipboard stockage allowances determined by the COSAL process result from a snapshot of the configuration and management data within the WSF, MDF, PSI, and Technical Reference File and other allowance significant UICP files. Because of the dynamic nature of these files successive allowance computations on a single ship's configuration would result in different stockage allowances.

The CNO's performance objectives for COSAL allowances are to fill 65 percent of all repair part demands from onboard stock (gross effectiveness) and 85 percent availability for onboard allowance items (net effectiveness). The gross effectiveness goal means that 65 times out of 100 the shipboard repairman should find the needed repair part in the ship's storeroom. The net effectiveness goal means that if the required repair part is an onboard stockage allowance item, then 85 times out of 100 it should be onboard when needed. The monitoring of COSAL effectiveness throughout the fleet has indicated that actual COSAL performance is closer to 50 percent gross effectiveness. [Ref. 15]

7. Bagby Study

In 1972, as a result of poor COSAL performance and a concern over the level of supply support being provided, the CNO sponsored a study of afloat logistic support performed by the Center for Naval Analysis. [Ref. 15]

The Center for Naval Analysis study, known as the Bagby study, identified some major shortcomings in the way the Navy determined shipboard allowance levels. As a result of the Bagby study, several changes to CNO allowance development policy and COSAL computation methods were recommended.

Among the most significant findings of the CNA study was that existing allowance development methods were unable to distinguish between the support requirements for mission essential equipment and equipment of lesser importance. What this meant was that the .25 FLSIP model treated all equipment the same. The .25 FLSIP model applied the same allowance criteria to both mission critical equipment (e.g., missile, gun, and propulsion systems) and equipment of lesser criticality (e.g., laundry and galley equipment). Given that there are both economic and stowage constraints on shipboard stockage allowances, treating all equipment equally, regardless of mission essentiality, does not make sense.

The Bagby study also suggested that COSAL effectiveness may not be the best measure of COSAL

performance. The main objective of any level of inventory within the Navy is to improve fleet readiness. Therefore an appropriate measure of effectiveness for the Navy's supply (and inventory) system is how well it supports those equipments which degrade readiness.

The most significant changes to the COSAL process resulting from the Bagby study involved developing a system which recognizes and provides greater support for mission critical equipment. The MOD-FLSIP (Modified Fleet Logistic Support Improvement Program) and MCO (Maintenance Criticality Oriented) computation methods were developed to fulfill the needs identified by the Bagby study.

Figure 4 summarizes the major COSAL models. For all models, "u" represents the item population's expected annual replacement rate, "POP" is the item population, "RF" is the item's annual replacement rate (BRF or TRF), and "AQ" is the item's allowance quantity.

In the MODFLSIP model, Mission Criticality Code (MCC) is a measure of item importance and ranges from 1 (least important) to 4 (most important). For FLSIP and MODFLSIP models, demand based item ($u>4$) allowance quantities are always the expected number of replacements during a 90 day period ($u/4$), plus a fixed protection level ($1.28 \times \sqrt{u/4}$). This fixed amount provides the 90% probability against stock-out for a 90 day period. Because

FLSIP and MODFLSIP provide a fixed protection level against stock out, they are known as fixed protection models.

Trident and MCO techniques are variable protection level models. The allowance quantities computed by these models equal the expected 90 day replacements (u/4), plus a variable protection level based on item importance and price. The variable protection level is represented by t in the trident model and Z in the MCO model. In the Trident model, Mission Essentiality Code (MEC) is a measure of item importance and ranges from 95 (least important) to 116 (most important). In the MCO model, Maintenance Criticality Code (MCC) is a measure of item importance and ranges from 1 (least important) to 4 (most important).

MCC is a common acronym between MODFLSIP and MCO models. With both models, the MCC serves the same purpose, to stratify allowance item candidates by mission importance. However, MODFLSIP MCCs and MCO MCCs are not the same thing.

MODFLSIP Mission Criticality Codes are derived from the Navy's Casualty Reporting (CASREP) system. MODFLSIP MCCs are assigned to ship class/equipment combinations based on the mission impact of the equipment failure. MODFLSIP MCCs are maintained in the MCC matrix file at SPCC by NAVSEALOGSUPENGACT.

MCO Maintenance Criticality Codes were developed for the FFG-7 ship class based on it's unique maintenance strategy and a shipwide logistic support analysis. The MCO

MCCs are maintained in the FFG-7 database by the Navy Maintenance Support Office (NAMSO).

| Name | Equation | Conditions |
|---|---|---|
| FLSIP | $u = POP \times RF$ <br> $AQ = 1$ | $.25 \le u \le 4$, item coded V1 (vital) |
| | $AQ = u/4 + (1.28 \times \sqrt{u/4})$ | $u > 4$ 90% probability of no stock out in 90 days |
| MODFLSIP | $u = POP \times RF$ <br> $AQ = 1$ | $.25 \le u \le 4$, MCC 1 and 2 equipment |
| | $AQ = 2$ | $.10 \le u \le 2$ MCC 3 and 4 equipment |
| | $AQ = 2$ | $2 < u \le 4$ MCC 3 and 4 equipment |
| | $AQ = u/4 + (1.28 \times \sqrt{u/4})$ | $u > 4$ 90% probability of no stock out in 90 days |
| TRIDENT | $u = POP \times RF$ | |
| | MEC 116 Items | |
| | $AQ = u/4 + (t\sqrt{u/4} + .5)$ | $t = \max \begin{cases} 1.3 \\ 7 - \log_{10}(\text{price}) \end{cases}$ |
| | MEC < 116 Items | |
| | $AQ = u/4 + (t\sqrt{u/4})$ | $t = \max \begin{cases} 1.3 \\ 7-((116-MEC)/6) - \log_{10}(\text{price}) \end{cases}$ |
| MCO | $u = POP \times RF$ | |
| | $AQ = u/4 + (Z\sqrt{u/4})$ | |
| | $Z = \max\{\text{min risk}, (3 + MCC - 1.5\log_{10}(\text{item price}))\}$ | |

Figure 4. COSAL Computation Techniques

## C. THE INCREMENTAL STOCK NUMBER SEQUENCE LIST (ISNSL)

### 1. ISNSL Development Background

The Incremental Stock Number Sequence List (ISNSL) is a computer application used to identify on-board repair parts (OBRP's) during the new construction of ships. The ISNSL is a Uniform Inventory Control Point (UICP) program developed by the Fleet Material Support Office (FMSO), Mechanicsburg, PA.

Shipbuilding contracts require the shipbuilder to furnish an initial range and depth of spare and repair parts for contractor supplied equipment. The Navy provides repair parts support for government furnished equipment. Prior to the development of the ISNSL method, shipbuilding contractors submitted Provisioning Technical Documentation (PTD) for equipment requiring repair parts support. From an inspection of the PTD it is determined if the equipment has been previously provisioned or if initial provisioning is required. If the equipment has been previously provisioned the existing Allowance Parts List (APL) is assigned, otherwise a new APL is developed during initial provisioning.

The APL identifies all maintenance significant parts and the range and depth of repair parts to be stocked onboard the ship. Many shipbuilders procure the items required for onboard stockage by individual equipment,

without consideration of the duplicity of identical parts between equipment. For example, shipbuilders would buy the repair parts required for the fresh water pumps separately from those needed for the condensate pumps. Although these pumps have different APL numbers and perform different functions, they frequently have common repair parts. Since total ship repair part allowances are computed by accumulating all installed equipment and considering repair parts collectively for stockage, this method resulted in either insufficient or excessive material being bought by the contractor. In general, both excesses of common material and the shortages of unique items resulted.

The repair part purchasing methods used by new construction ship contractors varies among shipyards and sometimes between ships within the same shipyard. Some shipbuilders buy spares and repair parts in multiple "ship set" quantities while other builders buy a single "ship set" at a time. Therefore, during a ship or ship class construction period the same equipment can be bought, installed and provisioned on several occasions. Even if comprehensive consolidated procurement methods were used by the shipbuilding contractor, there is no way for the equipment provisioner to identify repair part commonality across different equipment and components and forward that information to the shipbuilder. The equipment provisioner is an expert on the support requirements of individual

equipments, not the support requirements of an entire ship. It is the purpose of the ISNSL and COSAL processes to identify repair part commonality among different equipments installed on a single ship.

In the development of the ISNSL, there existed a methodology which permitted the consideration of multiple applications of identical equipment within a ship, and the commonality of repair parts across different equipment in the stockage determination process. The ISNSL also provided the shipbuilding contractor with the ability to buy repair parts in consolidated contracts rather than with a variety of individual repair part purchases amended to equipment procurements. [Ref. 16]

Prior to the ISNSL process the ability to distinguish between repair parts supporting Government Furnished Equipment (GFE) and those needed to support Contractor Furnished Equipment (CFE) was difficult. The repair parts required to support CFE are known as Contractor Furnished Materials (CFM) while those needed to support GFE are known as Government Furnished Materials (GFM). The use of the COSAL for this purpose was not viable because the COSAL does not distinguish between GFM and CFM. The COSAL only provides range and depth of spares and repair parts.

An additional problem with reliance on the COSAL as the only new construction ship allowance development and outfitting tool was that it provided a total ships

configuration and repair parts requirement only near the end of the ship's construction period. The time when the COSAL would be available would not provide adequate procurement lead time to buy required repair parts to meet the shipbuilding schedule. [Ref. 16]

2. The ISNSL Process

Recognizing the need to develop a uniform automated method of determining new construction ship repair part range and depth requirements, the Naval Sea Systems Command and the Naval Supply Systems Command assigned the Fleet Material Support Office to develop the Incremental Stock Number Sequence List (ISNSL).

During the ship construction period, configuration information is sent to the Weapons Systems File (WSF) to form an equipment/component configuration data base. The methods by which this configuration is submitted to the WSF and the level of detail varies and depends on each shipbuilding contract. By extracting the ship configuration data at selected times agreed upon within the shipbuilding contract, shipboard allowances can be computed for the equipment which is installed to date. This procedure allows the determination of spare and repair part requirements with consideration of commonality of material across the existing equipment population. The configuration reporting requirements identify the equipment as being contractor or government furnished and thereby identify the required

spares as being contractor or government furnished. Subsequent ISNSL computations are compared with previous ISNSL requirements to determine appropriate stockage adjustments.

The primary objectives of the ISNSL process are:

a. To distinguish between contractor and government furnished material.

b. Identify spare and repair part requirements at pre-determined intervals during the ship construction process.

c. Identify commonalty of parts between equipment

d. Provide methods and aids to the shipbuilding contractor for consolidating buys of like parts.

e. Compute repair part allowances under the authorized model. (The ISNSL process can be used with any COSAL computation.)

f. Provide a method of identifying required allowance material sufficiently in advance of required delivery dates to allow for timely procurement.

The ISNSL computer programs are run at the Ships Parts Control Center, Mechanicsburg, PA. They are typically run monthly depending on allowance document scheduling and workload requirements. ISNSL programs closely interact with the COSAL process in determining new construction repair part requirements. In a sense, the ISNSL program can be

viewed as calling the COSAL process during execution. [Refs. 5,16]

Individual ship configuration information is the basis for the computation of ISNSL products. Configuration information is reported to the Inventory Control Point by the construction shipyard or other designated activity. This information is used to update the configuration portion of the ship's Weapon System File (WSF).

This configuration update is typically done on a monthly basis. Under many shipbuilding contracts the Fitting Out Management Information Systems (FOMIS) is used to provide configuration status accounting information. The configuration data contained in FOMIS is used to load the applicable data elements within the WSF level A, while equipment provisioning efforts load repair part information for each equipment within the WSF level C, and also into the MDF and PSI.

The COSAL programs are used to extract configuration and repair part information from the WSF and other supporting UICP files. The extracted data is then processed through the appropriate mathematical model to provide ISNSL allowances. Follow-on ISNSL/COSAL computations use information from the previous run to determine the net repair part stockage increases, decreases and deletions. The final ISNSL is produced concurrently with the ship's

Load COSAL. Figure 5 summaries the organization, interfaces and data flow of the ISNSL program.

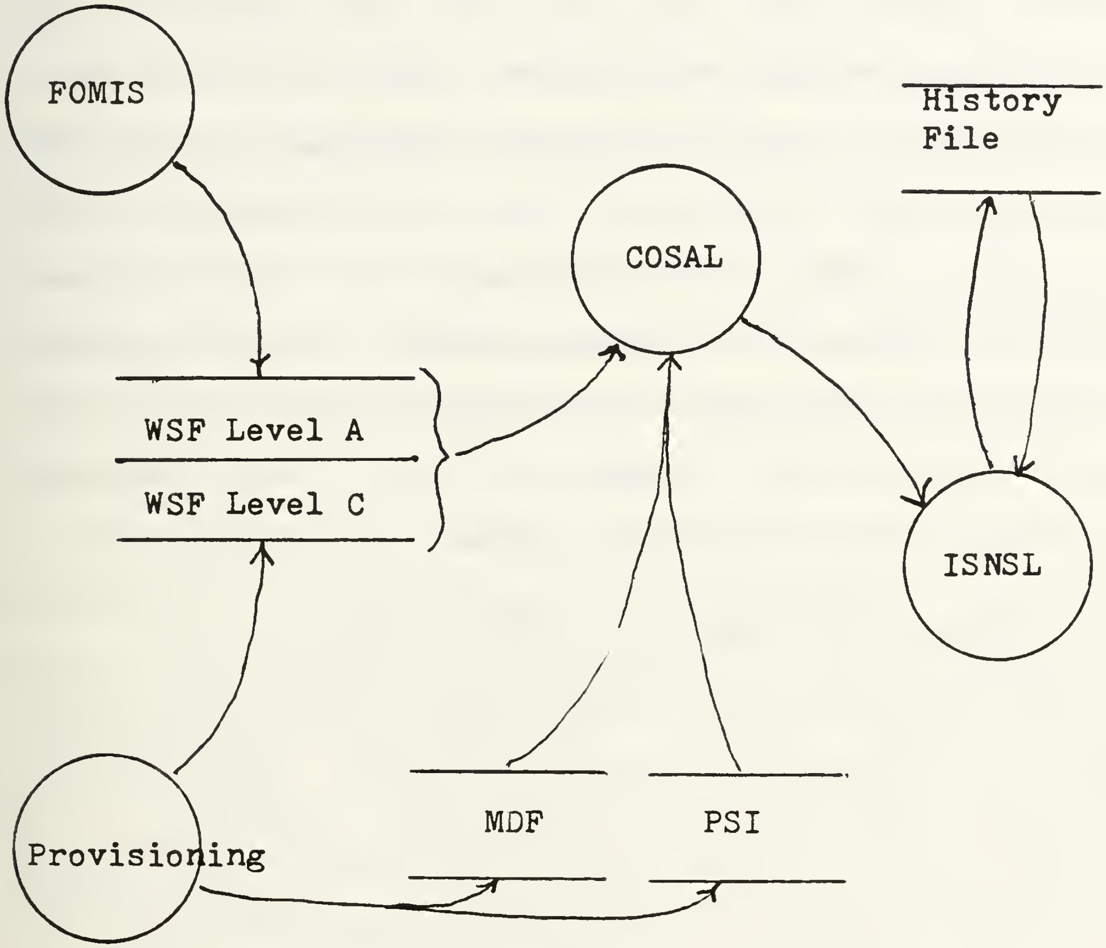


Figure 5. ISNSL Program Interfaces

The ISNSL process permits the identification and procurement of spare repair part allowances considering lead time. Through a method of identifying common equipment and components and summing their support requirements prior to

allowance computation a first step is taken in reducing the excess materials accumulated throughout a shipbuilding program. This first step was significant, but in light of increased shipbuilding activity and the complexity and expense of new shipboard equipment, this first step is no longer sufficient. Recent shipbuilding programs have been accumulating excess spare and repair part allowances at an alarming rate [Ref. 1]. Although the ISNSL process provides a method for consolidating ship allowance requirements it does not address the problems of excess material accumulation caused by an ever changing configuration and piece part data base.

## D. NEW CONSTRUCTION CONFIGURATION DEVELOPMENT

Broadly, configuration status accounting is the booking process of recording a ship's equipment installations, modifications and deletions from the WSF. The profile of a ship's installed equipment is known as a configuration index. The configuration index of each Navy ship is contained in Level A of the Weapons Systems File (WSF). The basis of shipboard supply support rests with the accuracy and validity of it's configuration index within the WSF. The establishment of a ship's configuration index is the responsibility of the HSC and is often delegated to the shipbuilding contractor or Naval Supervisory Activity (NSA). The Fitting Out Management Information System (FOMIS) and

Preliminary Equipment Configuration Index (PECI) are two methods commonly used by the HSC to develop the configuration index within the WSF for new construction ships.

FOMIS is a computer based integrated management system developed by the Naval Sea Systems Command. The purpose of FOMIS is to provide:

1) A configuration status accounting system
2) A management oriented logistics information system
3) A centralized data base for Integrated Logistic Support (ILS) data.

The FOMIS program is run by SPCC and loads data into the WSF Level A. The configuration information reported by FOMIS is developed and submitted by an HSC designated activity for each shipbuilding program. FOMIS provides a method to define a ship's configuration and monitor progress towards index completion. FOMIS monitors the status of contractor and government furnished equipment installation and configuration reporting.

FOMIS records are established for each installed equipment and contain specific provisioning, procurement, maintenance, installation and validation information. Each FOMIS record is updated incrementally as progress is made towards completion of installation and provisioning activities. When an equipment's FOMIS record contains the necessary data elements to establish a WSF Level A record,

the WSF is updated to reflect the installation of that equipment on a specific ship. In short, FOMIS contains a broad base of logistic and supply support information developed incrementally throughout the ship's construction period and used to establish the ship's WSF Level A configuration index. The Fitting Out Management Information System (FOMIS) is currently used in FFG-7, SSBN-726 and CG-47 shipbuilding programs. [Ref. 17]

The Preliminary Equipment Component Index (PECI) system is a file containing prescribed technical data on equipments and components applicable to a specific ship. SPCC develops and maintains the PECI file based on information supplied by the HSC, Naval Supervisory Activity and shipbuilder. PECI was originally developed as a manual configuration reporting system unlike the mechanized FOMIS process. The PECI input of equipment adds, deletes and changes is based on the NAVSUP Form 1174. PECI has evolved into a partially automated system in that images of Form 1174 records are transmitted to SPCC on magnetic tape for loading to the WSF Level A. The PECI configuration reporting system is currently used on SSN-688 and CVN/CV SLEP (Ship's Life Extension Program) programs.

Regardless of the configuration reporting method used during ship construction, the key aspect of configuration development is accuracy. Accurate reporting of installed equipment is critical to allowance development.

The validation of a ship's installed equipments and accurate configuration reporting to the WSF are critical to the overall allowance development effort. Inaccurate configuration reported to the WSF during the allowance development period often results in buying too much or too little of needed repair parts.

Equipment validation is the process of assuring that the ship's installed equipment corresponds to the information provided to the WSF. Sight validation is the physical identification of equipment by a knowledgeable technician who verifies the equipment installation by comparing configuration records with actual equipment label plate data. Sample validation involves the review of technical drawings and blueprints to determine installed equipment characteristics.

Clearly, the accuracy of a ship's configuration index is crucial to the allowance development process. Inaccurate configuration information which is included in early ISNSL allowance computations and subsequently deleted in later ISNSL allowances, result in unneeded repair part purchases and excess material. Inaccurate configuration reporting is thought to be a factor contributing to the accumulation of excess allowance materials. [Ref. 1]

## E. THE BEST REPLACEMENT FACTOR (BRF)

The Best Replacement Factor is a numeric representation of the expected annual number of replacements per part or component installed. The BRF has it's origin in engineering reliability theory. Initial BRF assignment and periodic BRF adjustments are designed to reflect the life cycle of equipment. The life cycle consists of; an infant mortality period, a constant failure rate period and a wear out period (see Figure 6).

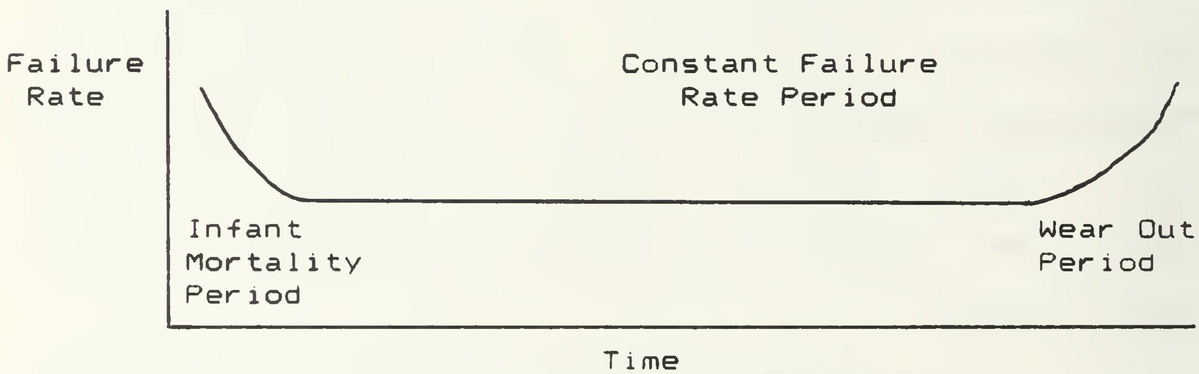


Figure 6. Bathtub Shape of the Reliability Curve

The BRF estimates item replacement rather than item failure because repair parts are often replaced prior to failure. Examples of replacement prior to failure include preventative maintenance, such as filters changes or the replacement of gaskets during an equipment overhaul. An understanding of the BRF is important because of it's vital role in the computation of a repair part for allowance. [Ref. 18]

The replacement factor assigned to a new item of supply represents an engineering estimate. It is based on technical judgment and experience with similar items at the time of initial provisioning. The initial assignment of a replacement factor is known as a Technical Replacement Factor (TRF). As data is collected through the Navy's maintenance and parts use reporting systems and a demand pattern is established, the TRF is adjusted appropriately and becomes a BRF. The demand development period, or TRF to BRF transition period, is typically one to two years. After this period the TRF is combined with actual use data using a weighted average technique to arrive at the BRF.

The initial estimate of the replacement factor is very influential and has lasting consequences on the supply support of new equipment. An initial TRF which is too low will result in inadequate spare parts inventories both ashore and afloat. TRFs which are too high result in stocking too much.

TRFs are only assigned to new items of supply (no NSN assigned). If an item has been catalogued through previous provisioning, the items assumes the existing BRF value without regard to application. An important point to note is that an item has a single BRF, which applies to that item regardless of application. For example, if identical "O-rings" are installed on two different equipments, the BRF

for those O-rings are the same without regard to their application.

The Best Replacement Factor (BRF) is updated annually to include recent use and failure rate information in future supply decisions. The sources of information used for BRF updating are:

1) The Navy 3M (Maintenance Material Management) database

2) The Mobile Logistic Support Force (MLSF) database

3) The SPCC Transaction History File.

The method of updating the BRF has been under extensive study by the Fleet Material Support Office (FMSO), Mechanicsburg, PA. [Ref. 18]

Currently a weighted average method is used to annually recompute the BRF for each repair part. This method combines old BRF values with data from the current year. The smoothing weight places more emphasis on historical BRF data (about 60%) and less emphasis on an item's current behavior (about 40%). This weighting is based on the logic that an item's use over time is a more accurate portrait of it's failure rate than a single year's data.

Alternative methods to update the BRF have been proposed. The alternatives include an adaptive smoothing technique based on the variation of average annual usage and a ratio computation method which computes BRF using total lifetime demand and average annual population.

The annual BRF update has been accused of causing a large portion of the ISNSL churn and resulting outfitting material excesses. The current weighted average BRF updating method allows a single year's usage to dramatically affect new BRF values. The recommended alternative BRF updating are designed to attenuate the affect of a single year's usage data on BRF value.

The BRF is a key factor in the allowance development process. It's value will determine whether an item will be stocked aboard ship or remain stocked only in the wholesale supply system. Because of the BRF's vital role, it's annual adjustment affects the time phased allowance development procedures used by SCN shipbuilding programs.

A ship will receive several ISNSL computations over a three or four year period. Some of these ISNSL computations will bracket an annual BRF update. An ISNSL stockage computed before and then after an annual BRF adjustment will result in different spare and repair part allowances.

## F. SUMMARY

Chapter II provided a broad perspective of the environment, procedures, activities and factors involved in the SCN allowance development process. These activities include logistic and maintenance planning, provisioning, configuration development and ISNSL/COSAL stockage computation. The factors considered by each specific

allowance computation model are an output of the provisioning and configuration development process. These factors include equipment and parts population sizes, maintenance code decisions, equipment criticality decisions, and BRF. Any changes in these factors can result in changes in allowance quantities (either additions or deletions) and in the accumulation of excess outfitting material.

Perhaps the most influential factors involved in allowance adjustments and ISNSL churn are configuration changes and BRF updating. The following chapters attempt to isolate and quantify the affects these factors have on ISNSL churn.

# III. INVESTIGATIVE FRAMEWORK

## A. BACKGROUND

Chapter II introduced the environment and processes of the SCN initial computation of repair parts stockage aboard ship. Many logistic and engineering decisions made early in the shipbuilding process have a significant impact on initial allowance computation and supply support. The Logistic Support Analysis (LSA) and maintenance concept are examples of these decisions.

Before the first equipment is provisioned by the ICP or the first configuration record is entered in the WSF these "front end" decisions have established a foundation upon which initial shipboard allowances are determined. Once made, these decisions generally remain constant throughout the initial allowance development period. Because of this static nature these "front end" decisions have little impact on the ISNSL churn and allowance excess issue. On an individual equipment basis, major changes in maintenance philosophy during the allowance development period will result in adjusted repair part support and ISNSL churn. Fortunately, these changes are made infrequently.

A further understanding of ISNSL churn and it's relationship to excess outfitting material is needed at this point. ISNSL churn and excess outfitting materials are not

interchangeable terms. The term ISNSL churn refers to the change in allowed shipboard stockage levels. These changes occur during the period of time over which the ship is being built. ISNSL churn includes inventory range adjustments and depth adjustments.

Excess outfitting materials refer to those items ordered and received based upon an ISNSL computed early in the shipbuilding process which are not part of the final ship's ISNSL and Load COSAL stockage allowance. Clearly excess outfitting material is more closely associated to ISNSL range deletes and depth decreases than ISNSL additions. If every allowance item on every ISNSL was ordered and received prior to the computation of subsequent ISNSL, then the ISNSL deletes would closely resemble the outfitting excesses. However, this condition is not the case. ISNSL re-computations are typically spaced six to nine months apart and the requisition processing time, procurement lead time and outfitting requirements policies often preclude filling every outfitting requisition before the next ISNSL is produced. This results in the canceling of outstanding outfitting requisitions prior to receipt of material. In short, excess outfitting materials are a subset of the ISNSL deletions experienced by a ship during it's allowance development and outfitting.

Just as ISNSL deletes do not always result in outfitting material excesses, not all excesses result from the ISNSL

process. For example, new weapon systems are often supported by the equipment manufacturer or other contractor early in the equipment's life cycle. This allows the Navy adequate time to plan the provisioning of the equipment and procure needed spares and repair parts for wholesale and retail support. During this period of contractor support, initial onboard allowances are computed for the ship by the HSC or equipment vendor. Repair parts stocked under these circumstances are known as Type III spares.

As contractor supported equipment is provisioned and the WSF database is loaded, the corresponding ISNSL allowance computations must be ignored by the outfitting activity. If this process breaks down, ISNSL allowance items are ordered and received in excess of the Type III items authorized for allowance. While this type of excess must be prevented it is not a direct result of the ISNSL process and ISNSL churn.

Of the factors affecting an item's allowance computation, the Best Replacement Factor (BRF) and WSF configuration changes are thought to be the two primary causes of ISNSL churn [Ref. 2]. The following analyses were done in an attempt to isolate these factors and determine their impact on ISNSL churn:

1) A Statistical analysis of SSBN-726 Trident Submarine ISNSL products

2) A statistical analysis of Third and Fourth Flight FFG-7 Class Guided Missile Frigate ISNSL products.

The tools of statistical analysis used include multiple linear regression, variance analysis and mean comparisons. The regression analysis attempts to describe the relationships between ISNSL churn, configuration changes and BRF adjustments. Variance analysis and mean comparisons attempt to identify differences in ISNSL churn between the categories of ISNSL and COSAL allowance material. Further, an effort is made to isolate the affects of annual BRF updating on ISNSL churn.

The FFG-7 and and SSBN-726 shipbuilding programs were selected for analysis for the following reasons:

1) Both ship classes had complete ISNSL statistics available for 24 ships.
2) The FFG-7 and SSBN-726 programs use similar COSAL computation models.
3) Both FFG-7 and SSBN-726 programs use FOMIS for WSF configuration reporting.
4) The FFG-7 shipbuilding program is executed at three shipyards and supervised by three NSAs. The FFG-7 FOMIS reporting responsibilities spread among all NSAs and the Ship Project Manager. The SSBN-726 submarines are built at a single shipyard with a single activity responsible for FOMIS configuration development. The difference between these two programs permit comparisons between centralized and distributed configuration

reporting responsibilities and the effect of configuration reporting on ISNSL churn.

## B. METHODOLOGY

ISNSL statistics on FFG-40 through FFG-58 and SSBN-727,729,730,731 and 733 were collected from the Ships Parts Control Center (SPCC), Mechanicsburg, PA. These ISNSL statistics include summary information on configuration, authorized allowance, allowance additions, and allowance deletions from one ISNSL to the next. This data is broken down by equipment supplier ; Government Furnished (GF) or Contractor Furnished (CF)) and storage location; Storeroom (SRI) or Operating Space ( OSI).

The annual BRF update at SPCC generally occurs in the June/July time frame. By identifying those ISNSL allowances affected by an annual BRF update and comparing them with ISNSL computations not affected by annual BRF updating the impact of BRF updates on ISNSL churn may be partially isolated. This comparison is made through a series of statistical tests applied to the ISNSL data within each group (Third Flight FFGs, Fourth Flight FFGs, and SSBN-726) to determine if churn differs between those ISNSL allowances affected by an annual BRF update and those which were not. Additionally, comparisons are made between groups to determine if BRF update behaves similarly regardless of ship class.

Using ISNSL statistics to isolate the impact of configuration changes on ISNSL churn is less conclusive. ISNSL configuration statistics identify only net adjustments to a ship's Weapon Systems File (WSF) configuration and do not provide information on specific equipments added or deleted. For example, the ISNSL configuration summary report may indicate a total range adjustment of 100 added configuration records (APLS/AELs) and a total depth adjustment of 250 additional configuration records. This information provides few clues about how many repair parts are involved in the configuration changes reported since the last ISNSL was computed.

Not all configuration records affect supply support and onboard allowances equally. Some equipments have few repair parts on their APLs while others have many. Therefore the impact of configuration changes on ISNSL allowances greatly depends on what equipment is involved with the configuration changes. It is important to recognize this shortcoming in the analysis of configuration changes and their impact on ISNSL churn. Additionally, the WSF is a steadily growing database during construction. Configuration deletions are few compared to the total number of transactions.

In addition to the above, a review of ISNSL range and depth deletions is conducted. The purpose of this review is to characterize the nature of ISNSL deletions and draw some

conclusions about their effect on afloat support and ISNSL churn.

The ISNSL data from SPCC has separated into three groups:

1) Third Flight FFG-7 class ships (FFG-40 through FFG-49)

2) Fourth Flight FFG-7 class ships (FFG-50 through FFG-58)

3) SSBN-726 class submarines.

The FFG-7 class ships are separated by flight because of differences in their configuration during the outfitting period.

Within each group the ISNSL configuration and allowance data is stratified by supplier (Government or Contractor), storage location (Storeroom or Operating Space) and occurrence of an annual BRF update. This was done to isolate the affects of configuration changes and annual BRF updating on allowance additions and deletions (ISNSL churn).

The number of ISNSLs computed per ship during initial allowance development varies between groups and from ship to ship within groups. Third Flight FFG-7s received 4 ISNSLs during the allowance development period while Fourth Flight FFG-7s received 3. The reduction from four to three ISNSLs on FFG-7s was made for three reasons; 1) the Fourth Flight FFG-7 construction and delivery was accelerated three to six months, reducing the time frame from first ISNSL to final ISNSL computation and Load COSAL, 2) the Fourth Flight FFG-7's configuration baseline was believed to be more stable

and 3) most major FFG-7 class weapon systems had completed the provisioning process.

The SSBN-726 class submarines have received a variable number of ISNSLs during allowance development. Submarines built early in the program received as many as ten ISNSL computations while those currently under construction received only two. The reduction in ISNSL computations reflects the stabilized configuration of the ship class and the completion of most major weapon system provisioning. The SSBN-726 class configuration is thought to be greater than 98 percent identical between each submarine. This similarity between hulls is due to the following; 1) a single shipbuilder constructing all SSBN-726 submarines and 2) high standardization requirements placed on strategic weapon systems by the Navy's Strategic Systems Project Office (SSPO).

In contrast to the equipment standardization on SSBN-726 submarines the configuration of FFG-7 class ships is believed to be 70 to 80 percent identical [Ref. 18]. The FFG-7 class has been constructed at three shipyards. Although the FFG-7 class represents a substantial improvement in equipment standardization among surface ship programs, it has a much greater equipment variety than the SSBN-726 class.

Throughout the analysis, each ship's first ISNSL data has been omitted. This is because the first ISNSL

computation reflects the initial stockage allowance and therefore no ISNSL churn has occurred.

Within each data group a three-fold approach will be taken to determine the causes of ISNSL churn. First, the relationship between configuration changes, annual BRF updating and ISNSL churn is examined. Correlation and regression analysis tools are used for this purpose.

Secondly, ISNSL allowance additions are examined. Allowance additions are analyzed in general and then decomposed by supplier, storage location and occurrence of an annual BRF update. Mean comparisons and analysis of variance are used for this analysis. Finally, ISNSL allowance deletions are studied in a manner similar to ISNSL allowance additions.

The theoretical foundations of the statistical analysis is based on an assumption of random sampling from an infinite population. This theoretical approach is not without limitations. The use of finite population adjustments or non-parametric procedures on statistical testing of ISNSL data can be argued as appropriate. However, because the SSBN-726 and FFG-7 data represents a near census of the population, the use of finite population correction factors will not significantly alter the results. Additionally, concern over occasional outlier data points supports the use of non-parametric procedures. It is beyond the scope of this research to analyze ISNSL data under all

three statistical assumptions (finite population, infinite population and non-normally distributed population).

Random, uniformly distributed and infinite population statistical assumptions have been used because of their conservative results. The use of finite population adjustments may lead to overly strong conclusions regarding the affects of configuration changes and BRF updating on ISNSL churn. Non-parametric tests (Mann-Whitney and Wilcoxon procedures) were performed on ISNSL data. The results of the non-parametric tests do not differ significantly from those tests using parametric statistical techniques. Therefore, non-parametric test results have not been included.

The specific computations used in the ISNSL data analysis are described below.

1. Correlation and Regression Analysis

These computations attempt to study and measure the statistical relationships between configuration, annual BRF updating and ISNSL churn. Correlation analysis measures the degree of statistical closeness between variables. Of interest in this case is how closely configuration changes and annual BRF updating are related to ISNSL churn. Regression analysis develops an estimate of the specific mathematical form of the relationships between the variables. Regression analysis describes the pattern of variable relationships. [Refs. 19,20]

### 2. Comparisons of Means, Confidence Intervals and Analysis of Variance

These computations attempt to determine if ISNSL churn is affected by BRF updating and if various categories of allowance material behave differently with regard to BRF updating. Mean comparisons determine if there is a statistical difference between mean values of different populations. In this case the mean or average percentage of ISNSL additions and deletions will be compared.

Confidence interval tests provide a range of mean population values based on sample means and the variation within the samples.

Analysis of variance testing attempts to determine if the variation between population samples is significant given the variation within each sample. For example, given the difference in variation between FFG-7 and SSBN-726 ISNSL churn, is this difference significant considering the variation within FFG-7 and SSBN-726 ISNSL churn? [Ref. 20]

## C. SUMMARY

The methodology used to conduct research for this thesis has been outlined in the preceding chapter. Through a statistical comparison of ISNSL records from FFG-7 and SSBN-726 class shipbuilding programs it is hoped that the effects of configuration changes and BRF updating on ISNSL churn become more evident. Through understanding the causes of

ISNSL churn, corrective actions can be recommended to reduce it. Reduction in ISNSL churn may in turn reduce the amount of excess outfitting material accumulated during the SCN allowance development process.

# VI. ANALYSIS AND DISCUSSION OF DATA

## A. DATA ORGANIZATION AND PRESENTATION

Chapter II introduced the SCN initial allowance development process, and described it's implementation and supporting programs. The purpose was to provide the background from which ISNSL churn and the accumulation of excess initial outfitting material can be understood and evaluated. Chapter III outlined an approach to the study of ISNSL churn involving the analysis of FFG-7 and SSBN-726 ISNSL products. The purpose of this chapter is to present the results of this statistical analysis.

The data used in this analysis was obtained from SSBN-726 and FFG-7 class ISNSL products. Data tables, descriptive plots and test results are contained in Appendices A through P.

## B. SSBN-726 ISNSL DATA ANALYSIS

This section contains an analysis of SSBN-726 ISNSL data. Data from the lead ship in the class has been omitted because of the unusually high number of ISNSLs needed to complete allowance development and outfitting. The lead ship of a shipbuilding program typically experiences more configuration and allowance volatility because of the requirement to newly provision most major equipments.

The data analysis will be presented in the following order;

1) Correlation and regression analysis

2) Mean comparisons and analysis of variance

3) Discussion.

An additional qualification regarding the ISNSL data used in the following analysis is necessary. Unless otherwise stated, ISNSL allowance additions and deletions reflect item range only. ISNSL depth churn will be discussed separately.

1. <u>Correlation and Regression Analysis</u>

Appendix A contains the SSBN-726 ISNSL correlation and regression analysis. Table 1 summarizes the ISNSL data used for this analysis. Configuration range data represents the net number of configuration range changes (number of different configuration records changes) from the previous ISNSL. Configuration depth changes represent the total number of configuration records changed from the previous ISNSL. Adds and deletes represent allowance range additions and deletions (all suppliers and storage locations) from the previous ISNSL. Total churn is a summation of range adds and deletes. BRF update is a binary variable indicating the occurrence of an annual BRF update since the previous ISNSL computation (a 1 indicates a BRF update occurred, a 0 means a BRF update did not occur).

TABLE 1
SSBN-726 REGRESSION AND CORRELATION DATA

| | | Independent Variables | | | Dependent Variables | | |
|---|---|---|---|---|---|---|---|
| Hull | ISNSL | Config Range | Config Depth | BRF Update | Adds | Deletes | Total Churn |
| 727 | 2 | 53 | 264 | 1 | 3104 | 2655 | 5759 |
| 727 | 3 | 84 | 380 | 0 | 1006 | 2458 | 3464 |
| 727 | 4 | 32 | 392 | 0 | 1298 | 618 | 1916 |
| 727 | 5 | 0 | 113 | 1 | 1971 | 2551 | 4522 |
| 727 | 6 | 14 | 282 | 0 | 2325 | 1205 | 3530 |
| 729 | 2 | 52 | 224 | 1 | 2454 | 2194 | 4648 |
| 729 | 3 | 370 | 433 | 0 | 2382 | 1065 | 3447 |
| 730 | 2 | 223 | 2867 | 0 | 3025 | 2022 | 5047 |
| 730 | 3 | 386 | 381 | 1 | 4542 | 1984 | 6526 |
| 731 | 2 | 9 | 330 | 0 | 1272 | 1015 | 2287 |
| 731 | 3 | 68 | 135 | 1 | 2062 | 2144 | 4206 |
| 733 | 2 | 300 | 993 | 1 | 7768 | 6945 | 14713 |

Table 2 displays the results of correlation computations between all data variables in table 1. A review of the correlation results suggests the relationship between configuration changes and ISNSL range adds and deletes is weaker than the relationship between the occurrence of an annual BRF update and ISNSL range adds and deletes. Based on this information alone, ISNSL churn appears to be more closely associated with BRF updating than configuration changes on SSBN-726 submarines. However, there is no strong correlation between any single causative factor and ISNSL churn.

TABLE 2
SSBN-726 CORRELATION TABLE

| | Config Range | Config Depth | Adds | Deletes | Adds+ Deletes |
|---|---|---|---|---|---|
| Config Depth | 0.354 | | | | |
| Adds | 0.623 | 0.272 | | | |
| Deletes | 0.302 | 0.171 | 0.840 | | |
| Adds+Deletes | 0.492 | 0.234 | 0.964 | 0.954 | |
| BRF Update | 0.076 | -0.295 | 0.500 | 0.539 | 0.540 |

A simple regression equation using either configuration changes or BRF updating as the single independent variable does not result in a useful equation to describe ISNSL churn on SSBN-726 hulls. The correlation data of Table 2 supports the notion that no single variable has a strong relationship with ISNSL churn.

It is important to note that ISNSL churn involves two components, namely allowance additions and deletions. Although ISNSL deletions are of primary concern because of their relationship to excess outfitting material it is useful to determine if configuration and BRF changes affect ISNSL additions and deletions differently. Given that the ISNSL deletion and additions are generated from the same configuration data and are affected equally by BRF updates, it is important to know if the mean number of ISNSL range deletions and range additions are significantly different.

Table 3 displays the results of the t-test and analysis of variance computations on the number of range additions and deletions per SSBN ISNSL. These tests suggest

no difference between the mean number of adds and deletes. We can conclude that BRF and configuration changes probably affect them equally.

TABLE 3
SSBN ISNSL ALLOWANCE ADDITIONS VS ALLOWANCE DELETIONS
T TEST AND ANALYSIS OF VARIANCE

ISNSL Adds vs ISNSL Deletes T Test

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| ISNSL Adds | 12 | 2767 | 1844 | 532 |
| ISNSL Deletes | 12 | 2238 | 1628 | 470 |

95 PCT CI FOR MU ISNSL Adds - MU ISNSL Deletes: (-948, 2007)
TTEST MU ISNSL Adds = MU ISNSL Deletes (VS NE): T=0.75
P=0.46 DF=21.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 1681691 | 1681691 | 0.56 |
| ERROR | 22 | 66568176 | 3025826 | |
| TOTAL | 23 | 68249856 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL              N    MEAN   STDEV  --+--------+--------+--------+-
ISNSL Adds        12    2767    1844      (-----------*-----------)
ISNSL Deletes     12    2238    1628  (---------*---------)
                                       -+--------+--------+--------+-
POOLED STDEV =    1739             1500      2250      3000      3750
```

Multiple linear regression analysis was performed on the SSBN ISNSL data with more useful results than simple regression. ISNSL additions and deletions were used as the dependent variables. Configuration range, depth and the binary annual BRF update indicator were used as the independent variables.

The regression equation for ISNSL additions is:

ISNSL Adds = 638 + 6.21(Config Range) + 0.626(Config Depth) + 1902(BRF Update Indicator)

s = 1289 R-sq = 64.5%

The regression equation for ISNSL deletions is:

ISNSL Deletes = 690 + 1.66(Config Range) + 0.646(Config Depth) + 1924 (BRF Update Indicator)

s = 1443 R-sq = 42.9%

The standard error of the estimate ("s") measures the dispersion of data around the regression line. The standard error of the estimate is also known as the residual standard deviation. The standard error of the estimate is used to determine confidence intervals about the regression line. [Ref 20]

The coefficient of determination (R-sq) provides a percentage of the total variation in the dependent variable (ISNSL adds or deletes) which is explained by the differences in the independent variables [Ref. 20].

Because it appears ISNSL additions and deletions react similarly to configuration and BRF changes, it follows that they have similar regression equations.

2. Mean Comparison and Analysis of Variance

The following section attempts to answer questions about the impact of annual BRF updating on ISNSL churn. The analysis involves a series of statistical hypothesis testing procedures. The first step in the analysis is to group the SSBN ISNSL data to isolate the effects of annual BRF

updating on ISNSL additions and deletions. The second step is to compare the mean percentage of ISNSL churn between groups via hypothesis testing to determine any statistical differences. The percentage of ISNSL churn is defined as the range of ISNSL additions or deletions divided by the total range of ISNSL allowance items. For example, if an ISNSL had 1000 contractor furnished (CF) storeroom items (SRI) deletions and a total of 4000 contractor furnished storeroom items authorized, then ISNSL deletion churn would equal 25 percent for CF SRI stockage allowances.

In hypothesis testing of the equality or inequality of two sample means or percentages there are two possible conditions, the hypothesis is either true or false. The statistical significance desired determines the acceptance or rejection regions of the hypothesis. On any given hypothesis test an error may be committed in one of two ways.

The first kind of error, known as a Type I error, rejects the hypothesis as false when in fact it is true. For example, we reject the hypothesis that SSBN-726 ISNSL allowance additions affected by BRF updating are equal to those not affected by BRF updating when in fact it is true.

The second type of error, known as a Type II error, accepts the hypothesis as true when in fact it is false. The level of significant and sample size determines the probability of committing Type I and Type II errors. A 5

percent level of significance was used in all hypothesis tests (probability of rejecting the hypothesis erroneously is five percent). In all of the following hypothesis tests, SSBN-726 ISNSL data are used to estimate the mean and variation of the actual SSBN-726 ISNSL population. Because of this assumption, the t-test and t distribution is used. [Refs. 19,208,21]

ISNSL allowances are divided in several categories based on the supplier of the parent equipment and the purpose and storage location of the material. Allowance items are designated as Contractor Furnished (CF)) if the shipbuilder supplied the parent equipment, and Government Furnished (GF) if the Navy or other government agency provided the equipment. In most SCN programs, mechanical and electrical equipment is contractor furnished while electronic and ordnance equipment is government furnished.

Within CF and GF supplier categories repair parts are further divided into storeroom items (SRI) and operating space items (OSI). Storeroom items are those spares and repair parts in the custody of the ship's Supply Department. They are stocked to meet forecasted recurring demand.

Operating space items are spares and repair parts stored in the same space as the installed equipment. Operating space items include Ready Service Spares (RSS), battles spares, and Maintenance Assist Modules (MAMS). Battle spares and RSS are supply department items stored in

the same space as the parent equipment to permit quick repair of equipment during battle conditions. MAMS are also stored in the same space as the parent equipment. However, MAMS are a part of the equipment's maintenance concept, function similarly to test equipment and are used primarily for fault isolation. Operating space items compute for allowance based on override or allowance note codes that bypass the full ISNSL/COSAL computation model. If operating space items bypass much of the ISNSL/COSAL computation process, it follows that changes to key allowance determinants (e.g., BRF) would affect OSI allowance computation less. With the above in mind an analysis of SSBN-726 ISNSL data follows.

a. SSBN-726 ISNSL Allowance Additions

Appendices B and C contain data and test results on SSBN-726 class ISNSL allowance additions. Appendix B looks at SSBN-726 ISNSL additions overall and attempts to answer the following questions:

1) Is there a difference between government furnished and contractor furnished ISNSL allowance additions without regard to BRF updating?

2) Is there a difference between SRI and OSI material ISNSL allowance additions without regard to BRF updating?

Appendix C decomposes the data into those ISNSLs affected by an annual BRF update and those not affected by BRF updating. Appendix C attempts to answer the following:

1) Is there a difference between the allowance additions on ISNSL's affected by an annual BRF update and those not affected by annual BRF updating?

2) Does annual BRF updating affect contractor furnished, government furnished, SRI and OSI allowance items differently?

Tables 4 and 5 display a summary of SSBN-726 class government and contractor furnished ISNSL allowance additions separated by storage location. These tables include the number of allowance items within each category (SRI or OSI) and the number of allowance additions resulting from the corresponding ISNSL. Figure 7 plots the percentage of ISNLS allowance additions displayed in Table 4.

TABLE 4
SSBN-726 GF SRI AND GF OSI ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | GF/SRI Allw | GF/SRI Adds | GF/SRI Adds % | GF/OSI Allw | GF/OSI Adds | GF/OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 4535 | 1428 | 31.4884 | 2204 | 494 | 22.4138 |
| 727 | 3 | 3332 | 411 | 12.3349 | 2193 | 51 | 2.3256 |
| 727 | 4 | 3480 | 359 | 10.3161 | 2163 | 172 | 7.9519 |
| 727 | 5 | 3527 | 653 | 18.5143 | 2275 | 339 | 14.9011 |
| 727 | 6 | 3885 | 1011 | 26.0231 | 2580 | 442 | 17.1318 |
| 729 | 2 | 4265 | 955 | 22.3916 | 3113 | 435 | 13.9737 |
| 729 | 3 | 4310 | 445 | 10.3248 | 3074 | 177 | 5.7580 |
| 730 | 2 | 3733 | 1318 | 35.3067 | 2650 | 1233 | 46.5283 |
| 730 | 3 | 4339 | 1309 | 30.1682 | 3246 | 1088 | 33.5182 |
| 731 | 2 | 4054 | 173 | 4.2674 | 3182 | 173 | 5.4368 |
| 731 | 3 | 4299 | 532 | 12.3750 | 2653 | 251 | 9.4610 |
| 733 | 2 | 4258 | 3499 | 82.1747 | 3209 | 2184 | 68.0586 |

```
      .   ::   .  .  .  ..  .                             .
+---------+---------+---------+---------+---------+-------
                     GF SRI Allowance Adds

. :..  ...   .       .        .             .
+---------+---------+---------+---------+---------+-------
0.00     15.00     30.00     45.00     60.00     75.00
                     GF OSI Allowance Adds
```

Figure 7. SSBN-726 GF SRI vs GF OSI ISNSL Allowance Additions Dotplot

TABLE 5
SSBN-726 CF SRI AND CF OSI ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | CF/SRI Allw | CF/SRI Adds | CF/SRI Adds % | CF/OSI Allw | CF/OSI Adds | CF/OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 6893 | 1088 | 15.7841 | 489 | 94 | 19.2229 |
| 727 | 3 | 7040 | 523 | 7.4290 | 456 | 21 | 4.6053 |
| 727 | 4 | 7200 | 761 | 10.5694 | 377 | 6 | 1.5915 |
| 727 | 5 | 6944 | 886 | 12.7592 | 400 | 93 | 22.2500 |
| 727 | 6 | 7117 | 755 | 10.6084 | 500 | 117 | 23.4000 |
| 729 | 2 | 6353 | 900 | 14.1665 | 633 | 164 | 25.9084 |
| 729 | 3 | 7225 | 1392 | 19.2664 | 935 | 368 | 39.3583 |
| 730 | 2 | 6385 | 454 | 7.1104 | 683 | 174 | 25.4758 |
| 730 | 3 | 7207 | 1778 | 24.6705 | 938 | 366 | 39.0192 |
| 731 | 2 | 7119 | 693 | 9.7345 | 927 | 233 | 25.1348 |
| 731 | 3 | 7193 | 977 | 13.5826 | 935 | 302 | 32.2995 |
| 733 | 2 | 6996 | 1953 | 27.9159 | 1004 | 162 | 16.1355 |

TABLE 6

SSBN-726 GF SRI VS GF OSI ISNSL ALLOWANCE ADDITIONS T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds vs CF SRI Adds

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 12 | 24.6 | 20.6 | 5.9 |
| GF OSI | 12 | 20.6 | 19.7 | 5.7 |

95 PCT CI FOR MU GF SRI Adds - MU GF OSI Adds: (-13.1, 21.1)
TTEST MU GF SRI Adds = MU GF OSI Adds (VS NE): T=0.49 P=0.63 DF=22.0

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 97 | 97 | 0.24 |
| ERROR | 22 | 8924 | 406 | |
| TOTAL | 23 | 9021 | | |

```
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL    N   MEAN   STDEV----------+---------+---------+------
GF SRI  12  24.64   20.61      (-------------*-------------)
GF OSI  12  20.62   19.66 (-------------*-------------)
                         ----------+---------+---------+------
POOLED STDEV =  20.14            16.0      24.0      32.0
```

Comparing the mean percentage of ISNSL allowance additions between supplier and storage location suggests whether the ISNSL computation process affects these material categories differently. Table 6 displays the results of t-test and analysis of variance comparisons between SSBN-726 GF SRI and GF OSI allowance additions.

The bottom line of the statistical analysis of Appendix B is that there appears to be no difference in the percentage of ISNSL allowance additions experience between GF and CF materials or SRI and OSI storage locations. The

analysis suggests that both contractor and government furnished material ISNSL allowance additions respond in similar ways to the ISNSL/COSAL computation process. They may be responding to different factors within the ISNSL process. Unfortunately, those factors cannot be isolated with the available data.

Appendix C contains the analysis of the affects of annual BRF updating on SSBN-726 ISNSL allowance additions. This analysis separates ISNSL data into two groups; 1) those ISNSLs which were computed after an annual BRF update and 2) those ISNSLs without an intervening annual BRF update. Within each group the ISNSL data is further categorized by supplier and storage location.

Appendix C initially compares SSBN-726 ISNSL allowance additions computed after an annual BRF update. Secondly, ISNSL allowance additions not affected by annual BRF updates are compared. Finally, ISNSL additions affected by annual BRF updating are compared with those not affected by annual BRF updates.

Table 7 summarizes the results of this analysis. Table 7 contains three matrices corresponding to the three comparisons above. A "yes" in Table 7 (or follow-on Table of similar format) indicates a statistical difference ,at a 95 percent level of significance, between supplier/storage location categories. A "no" indicates no significant difference between the allowance material categories.

Based on the statistical assumptions and a 95 percent level of significance, it appears there is no significant difference between SSBN ISNSL allowance additions affected by annual BRF updating and those not affected by annual BRF updating. The only exception to the above statement concerns contractor furnished storeroom items. On the average these items experienced 18.15% ISNSL allowance additions following a BRF update and 10.79% allowance additions without a BRF update.

Intuition suggests that those ISNSL's affected by annual BRF updating should experience higher levels of allowance adjustment. A second look at the data in Appendix C verifies that, without exception, ISNSL additions affected by annual BRF updating have higher mean allowance addition percentages and greater variation within those addition percentages than ISNSLs not affected by annual BRF updating. This suggests that BRF updating may result in greater ISNSL allowance additions and perhaps overall churn. Table 8 summarizes the results.

b. SSBN-726 ISNSL Allowance Deletes.

The analysis of SSBN-726 ISNSL allowance deletions is accomplished in the same manner as allowance additions. ISNSL deletion statistics do not distinguish between SRI and OSI items. Therefore, that portion of the analysis has been omitted.

TABLE 7
APPENDIX C SUMMARY

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | --- | NO | NO | --- |
| GF OSI | NO | --- | --- | NO |
| CF SRI | NO | --- | --- | NO |
| CF OSI | --- | NO | NO | --- |

T Test and Analysis of Variance Results Between
Supplier/Storage Location
Annual BRF Update a Factor

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | --- | NO | NO | --- |
| GF OSI | NO | --- | --- | NO |
| CF SRI | NO | --- | --- | NO |
| CF OSI | --- | NO | NO | --- |

T Test and Analysis of Variance Results Between
Supplier/Storage Location
Annual BRF Update Not a Factor

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | NO | --- | --- | --- |
| GF OSI | --- | NO | --- | --- |
| CF SRI | --- | --- | YES | --- |
| CF OSI | --- | --- | --- | NO |

T Test and Analysis of Variance Results Between
Supplier/Storage Location
Annual BRF Update a Factor vs Not a Factor

TABLE 8
SUMMARY OF MEAN AND STANDARD DEVIATION OF SSBN-726 ISNSL ALLOWANCE ADDITION PERCENTAGE

| | Annual BRF Update A Factor | | Annual BRF Update Not a Factor | |
|---|---|---|---|---|
| | Mean | Stdev | Mean | Stdev |
| GF SRI | 32.9% | 25.2 | 16.4% | 11.7 |
| GF OSI | 27.0% | 21.8 | 14.2% | 16.6 |
| CF SRI | 18.15% | 6.47 | 10.79% | 4.42 |
| CF OSI | 25.97% | 8.49 | 19.9% | 14.3 |

Appendix D contains SSBN-726 class ISNSL allowance deletion data and statistical test results performed without regard to the affects of annual BRF updating. Appendix D's analysis addresses the question of differences between contractor and government furnished material allowance deletions. The results of a t-test and analysis of variance between contractor and government furnished material deletion percentages suggests that the ISNSL process affects them equally without regard to annual BRF updating (see Table 60 of Appendix D).

Appendix E contains allowance deletion data stratified by the affect of annual BRF updates. These tests address the question of differences between ISNSL deletions, where annual BRF updating is a factor vs ISNSL deletion not affected by BRF updating. Once again, the observations regarding the impact of BRF updating on ISNSL additions apply to ISNSL deletions. The theoretical framework within which this analysis is being conducted suggests no significant difference between deletions affected by an annual BRF update and deletions not affected by BRF updating. However, the mean and variation of ISNSL deletes affected by BRF updating is consistently greater than those not affected by updating. Table 9 summarizes the ISNSL deletion data.

TABLE 9
SUMMARY OF MEAN AND STANDARD DEVIATION OF SSBN-726 ISNSL ALLOWANCE DELETION PERCENTAGES

| | Annual BRF Update A Factor | | Annual BRF Update Not a Factor | |
|---|---|---|---|---|
| | Mean | Stdev | Mean | Stdev |
| GF Deletes | 14.67% | 6.58 | 12.00% | 9.92 |
| CF Deletes | 26.6% | 28.3 | 8.82% | 5.39 |

3. Summary

The preceding analysis of SSBN-726 class ISNSL data suggests statistical differences between the amount of churn experienced by ISNSLs affected by annual BRF updating and those unaffected by the BRF updating process.

C. THIRD FLIGHT FFG-7 ISNSL DATA ANALYSIS

This section contains an analysis of Third Flight FFG-7 class (FFG-40 through FFG-49) ISNSL data. Selected ISNSL data from early Third Flight hulls was not available for analysis. In addition, the FFG-44 was built for the Royal Australian Navy under a foreign military sales (FMS) agreement and is not included in the analysis.

The approach towards FFG-7 class ISNSL data analysis is unchanged from that used on SSBN-726 ISNSL data.

1. Correlation and Regression Analysis

Appendix F contains Third Flight FFG-7 class correlation and regression analysis. A sequence of

scatterplots for the data has been included in Appendix F. There appears to be fairly strong correlation between ISNSL additions and configuration changes (both configuration range and depth changes) on Third Flight FFG-7s. The results of multiple linear regression between ISNSL allowance additions and deletions and configuration changes and BRF updates was found to be:

ISNSL Adds = 2459 + 1.09(Config Range) = 0.470(Config Depth)
+ 502(BRF Update Indicator)

The test statistics for this relationship were:

s = 993.2 R-sq = 83.1%

The relationship between ISNSL allowance deletions and configuration range changes and BRF updating was found to be:

ISNSL Deletes = 2331 + 0.302(Config Range) + 2214(BRF Update)

The test statistics for this relationship were:

s= 1578 R-sq = 38.6%

2. <u>Mean Comparison and Analysis of Variance</u>

The procedures used for comparison of means and variance on the Third Flight FFG-7 class ISNSL is also unchanged from the SSBN-726 Class approach.

a. Third Flight FFG-7 ISNSL Allowance Additions

Appendices G and H contain data and test results on Third Flight FFG-7 class ISNSL allowance additions. Appendix G addresses ISNSL additions without regard to annual BRF updating and attempts to isolate differences

between government/contractor and storeroom/operating space repair parts. Appendix H refines the analysis by distinguishing between ISNSL data affected by annual BRF updating and ISNSL data not affected by BRF updating.

The analysis of Third Flight FFG-7 class data indicates the following relationships regarding ISNSL additions:

1) Government and contractor furnished storeroom items experience about the same percentage of ISNSL additions.
2) Government furnished storeroom items experience a significantly greater percentage of ISNSL additions than government furnished operating space items.

Table 10 summarizes these results.

TABLE 10
APPENDIX G SUMMARY

| | Mean | Stdev |
|---|---|---|
| GF SRI | 26.89% | 14.92 |
| GF OSI | 13.45% | 9.16 |
| CF SRI | 26.40% | 11.10 |
| CF OSI | 21.30% | 11.08 |

Third Flight FFG-7 Class
Summary of ISNSL Addition Percentages

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | --- | YES | NO | --- |
| GF OSI | YES | --- | --- | YES |
| CF SRI | NO | --- | --- | NO |
| CF OSI | --- | YES | NO | --- |

Third Flight FFG-7 Class ISNSL Additions Test and Analysis of Variance Between Supplier/Storage Location

The difference between GF SRI and GF OSI allowance additions initially appears troublesome. However, as discussed earlier, a possible explanation for this difference is the manner in which stockage of storeroom and operating space items are computed. Generally, storeroom item allowances are computed via the full COSAL model criterion, whereas operating space items bypass much of this model. Stockage allowance for OSI are generally determined via override or note code data. Because operating space items are insulated from much of the computation model criterion, (including BRF) lower ISNSL additions for OSI spares may result.

Appendix H contains the analysis of Third Flight FFG-7 ISNSL allowance additions when annual BRF updating is considered. Once again, this analysis separates the ISNSL data into two groups; ISNSL data obtained after an annual BRF update and ISNSL data obtained without an intervening BRF update. With Third Flight FFG-7 data, the effects of BRF updating on ISNSL allowance additions are distinct. Both government furnished operating space and government furnished storeroom allowance items experience significantly greater ISNSL additions after an annual BRF update. The affects of BRF updating on contractor furnished allowance items are noticeable but less dramatic. Table 11 summarizes these findings.

TABLE 11
APPENDIX H SUMMARY

| | Annual BRF Update A Factor | | Annual BRF Update Not a Factor | |
|---|---|---|---|---|
| | Mean | Stdev | Mean | Stdev |
| GF SRI | 32.09% | 14.13 | 19.61% | 11.52 |
| GF OSI | 16.72% | 9.00 | 8.88% | 7.56 |
| CF SRI | 29.29% | 11.52 | 22.36% | 9.57 |
| CF OSI | 21.69% | 12.45 | 19.76% | 7.66 |

Third Flight FFG-7 Class
Summary of Mean and Standard Deviation ISNSL Allowance Additions

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | YES | --- | --- | --- |
| GF OSI | --- | YES | --- | --- |
| CF SRI | --- | --- | NO | --- |
| CF OSI | --- | --- | --- | YES |

T Test and Analysis of Variance Results Between Supplier/Storage Location
Annual BRF Update a Factor vs Not a Factor

b. Third Flight FFG-7 ISNSL Allowance Deletions

This section contains Third Flight FFG-7 class ISNSL allowance deletion data analysis. Appendix I attempts to distinguish differences between government and contractor furnished ISNSL deletions on Third Flight FFG-7s. The results of these tests suggest no difference between the percentages of deletions experienced by GF and CF material on Third Flight FFG-7s (see Table 95 of Appendix I).

Appendix J contains Third Flight FFG-7 allowance deletion data analysis stratified by the affect of annual BRF updating. These tests compare ISNSL deletes where annual BRF updating is a factor and ISNSL deletes unaffected by annual BRF updating. The results of these tests suggest that contractor furnished material experiences substantially fewer ISNSL deletes when not affected by annual BRF updating. Government furnished material data is far less conclusive, perhaps due to the effect of an apparent outlier in FFG-42's 4th ISNSL. Figure 8 illustrates the dramatic affect FFG-42's 4th ISNSL has on this analysis. Table 12 summarizes Appendix J.

```
              .
         . :..:     .                                   .
+---------+---------+---------+---------+---------+-------
                    GF Allowance Deletes
      ::::.   .
+---------+---------+---------+---------+---------+-------
0.00     12.00     24.00     36.00     48.00     60.00
                    CF Allowance Deletes
```

Figure 8. Third Flight FFG-7 GF vs CF ISNSL Allowance Deletions Dotplot - Annual BRF Update Not a Factor

TABLE 12
SUMMARY OF MEAN AND STANDARD DEVIATION OF THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS

| | Annual BRF Update A Factor | | Annual BRF Update Not a Factor | |
|---|---|---|---|---|
| | Mean | Stdev | Mean | Stdev |
| GF Deletes | 21.93% | 5.12 | 19.14% | 16.1 |
| CF Deletes | 21.66% | 2.49 | 10.0% | 2.79 |

### 3. Summary

The analysis of Third Flight ISNSL data suggests a higher percentage of ISNSL churn and greater variation of ISNSL churn on those ISNSL stockage allowance computed after an annual BRF update when compared to ISNSL allowances computed without an intervening BRF update. Additionally, the analysis indicates that operating space items experience less churn and are less affected by BRF updating than storeroom items. This observation indicates that changes to allowance computation related data elements within the Maintenance Data File (MDF) and Program Support Interest File (PSI) may have greater impact on ISNSL churn than minor configuration changes to the Weapon Systems File (WSF).

## D. FOURTH FLIGHT FFG-7 ISNSL DATA ANALYSIS

This section contains an analysis of Fourth Flight FFG-7 class (FFG-50 through FFG-60) ISNSL data. ISNSL data from FFG-59 and FFG-60 was not available at the time of this research.

### 1. Correlation and Regression Analysis

Appendix K contains the Fourth Flight FFG-7 class correlation and regression analysis. A series of scatterplots in Appendix K supports the correlation table and follow-on regression analysis. No single factor stands out as correlating well with either ISNSL allowance

additions or deletions on Fourth Flight FFG-7s. The use of multiple linear regression analysis is also of limited value. The multiple regression between ISNSL additions and deletions and configuration changes and the BRF update indicator yielded the following equations:

ISNSL Adds = 3170 + 2.17(Config Range) - 0.305(Config Depth) + 725(BRF Update Indicator)

The statistics for this relationship were:

s = 695.6 R-sq = 40.2%

The relationship between ISNSL deletions and configuration range changes and BRF updating was found to be:

ISNSL Deletes = 1931 + 0.62(Config Range) + 0.001(Config Depth) + 1318(BRF Update)

The statistics for this relationship were:

s= 505.1 R-sq = 69.9%

2. Mean Comparison and Analysis of Variance

The procedures used for Fourth Flight FFG-7 class ISNSL data mean comparisons and variance analysis remains is unchanged from previous analyses.

a. Fourth Flight FFG-7 ISNSL Allowance Additions

Appendices L and M contain data and test results on Fourth Flight FFG-7 class ISNSL allowance additions. Appendix L addresses ISNSL additions without regard to annual BRF updating and attempts to isolate differences between government/contractor and storeroom/operating space repair parts. Appendix M refines the analysis by

distinguishing between ISNSL data affected by annual BRF updating and ISNSL data not affected by BRF updating.

Fourth Flight FFG-7 class data suggests the following relationships regarding ISNSL additions:

1) Government and contractor furnished storeroom items experience about the same percentage of ISNSL additions.
2) Government and contractor furnished operating space items experience about the same percentage of ISNSL additions.
3) Government and contractor furnished storeroom items experience a significantly greater percentage of ISNSL additions than government and contractor furnished operating space items.

These observations support those for Third Flight FFG-7s and extend the difference between storeroom and operating space items to contractor furnished material. Table 13 summarizes the analysis of Appendix L.

The difference between SRI and OSI ISNSL allowance additions is clearly noticeable on Fourth Flight FFG-7s. Once again, a possible explanation for this difference is the manner in which stockages for storeroom and operating space items are computed. Because operating space items are insulated from much of the computation model's criterion (including BRF) lower ISNSL additions for OSI spares is

logical. The criterion considered by the COSAL computation model (maintenance level, item population, BRF, price, etc.)

TABLE 13
APPENDIX L SUMMARY

| | Mean | Stdev |
|---|---|---|
| GF SRI | 21.43% | 6.15 |
| GF OSI | 8.73% | 4.89 |
| CF SRI | 19.97% | 5.98 |
| CF OSI | 7.73% | 3.03 |

Fourth Flight FFG-7 Class
Summary of ISNSL Addition Percentages

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | --- | YES | NO | --- |
| GF OSI | YES | --- | --- | NO |
| CF SRI | NO | --- | --- | YES |
| CF OSI | --- | NO | YES | --- |

Fourth Flight FFG-7 Class ISNSL Additions
Summary of Test and Analysis of Variance Between
Supplier/Storage Location

are also the data elements within the MDF, PSI and WSF Level C which are subject modification. It follows that if operating space items are insulated from much of the ISNSL/COSAL computation process then they should also be insulated from much of the ISNSL/COSAL churn resulting from changes in item data within the files considered by the computation model.

Appendix M contains the analysis of Fourth Flight FFG-7 ISNSL allowance additions when annual BRF updating is considered. Once again, this analysis separates the ISNSL data into two groups; ISNSL data affected by

annual BRF updating and ISNSL data not affected by BRF updating. On Fourth Flight FFG-7 class ships the affects of BRF updating on ISNSL allowance additions is less distinct than on Third Flight FFG-7s. Only government furnished operating space and contractor furnished storeroom allowance items experience significantly greater ISNSL additions after an annual BRF update. Table 14 summarizes Appendix M.

TABLE 14
APPENDIX M SUMMARY

| | Annual BRF Update A Factor | | Annual BRF Update Not a Factor | |
|---|---|---|---|---|
| | Mean | Stdev | Mean | Stdev |
| GF SRI | 23.04% | 6.09 | 19.62% | 6.08 |
| GF OSI | 10.33% | 3.95 | 5.69% | 4.13 |
| CF SRI | 23.84% | 4.49 | 15.60% | 4.20 |
| CF OSI | 8.68% | 3.96 | 6.65% | 0.77 |

Fourth Flight FFG-7 Class
Summary of Mean and Standard Deviation ISNSL Allowance Additions

| | GF SRI | GF OSI | CF SRI | CF OSI |
|---|---|---|---|---|
| GF SRI | NO | --- | --- | --- |
| GF OSI | --- | YES | --- | --- |
| CF SRI | --- | --- | YES | --- |
| CF OSI | --- | --- | --- | NO |

Fourth Flight FFG-7 Class
Summary of T Test ans Analysis of Variance Results Between Supplier/Storage Location
Annual BRF Update a Factor vs Not a Factor

b. Fourth Flight FFG-7 ISNSL Allowance Deletions

Appendix N contains Fourth Flight FFG-7 class ISNSL allowance deletion data and the associated statistical tests. As with previous analysis, Appendix N attempts to distinguish differences between government and contractor furnished material ISNSL deletions on Fourth Flight FFG-7s. The results of these tests suggest that there is no difference between the percentage of allowance deletions experienced by GF and CF material on Fourth Flight FFG-7s (see Table 131 of Appendix M).

Appendix O describes the analysis of allowance deletions for Fourth Flight FFG-7s stratified by the affect of annual BRF updating. this analysis addresses the issue of ISNSL deletes where annual BRF updating is a factor vs ISNSL deletes where annual BRF updating is not a factor. The results of these tests suggest that government and contractor furnished material experience substantially fewer ISNSL deletes when not affected by annual BRF updating. Table 15 summarizes Appendix O.

TABLE 15
SUMMARY OF MEAN AND STANDARD DEVIATION OF FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETION PERCENTAGES

| | Annual BRF Update A Factor | | Annual BRF Update Not a Factor | |
|---|---|---|---|---|
| | Mean | Stdev | Mean | Stdev |
| GF Deletes | 16.63% | 2.95 | 11.21% | 3.14 |
| CF Deletes | 19.85% | 3.96 | 8.09% | 3.33 |

### 3. Summary

As with the analysis of Third Flight FFG-7 ISNSL data, Fourth Flight ISNSL data suggests a greater difference between the churn experienced by ISNSLs affected by annual BRF updating. The Fourth Flight data also reinforces the notion that operating space items experience less churn and are less affected by BRF updating than storeroom items. This observation shows that changes to data elements related to allowance computation within the Maintenance Data File (MDF) and Program Support Interest File (PSI) may have greater impact on ISNSL churn than minor configuration changes.

## E. FFG-7 AND SSBN-726 ISNSL CHURN COMPARISON

Perhaps the most significant analysis on the impact of configuration changes and annual BRF updates on ISNSL churn is made by comparing FFG-7 and SSBN-726 ISNSL data.

The SSBN-726 and FFG-7 class ships are supported by very similar COSAL computation models. FFG-7's receive allowances based on the Maintenance Criticality Oriented (MCO) computation model while SSBN-726 submarine allowances are based on the Trident model. Both models are variable protection level algorithms and consider similar factors in item computation (item population, equipment criticality, replacement factor, maintenance level, price, etc.).

Because of these similarities, it is unlikely that differences between FFG-7 and SSBN-726 ISNSL churn arise from different COSAL models.

Both FFG-7 and SSBN-726 programs use the FOMIS configuration loading method. Differences between stockage level computations in the two programs may arise when configuration control and standardization is considered.

The Trident submarine program is highly standardized and exercises close control on configuration. The FFG-7 program is not as closely managed regarding standardization or configuration control. Additionally, SSBN-726 submarine configuration is developed by a single activity while FFG-7 ship configuration is done by multiple activities.

With the above considerations in mind, if configuration management is a primary factor in ISNSL churn, one would expect SSBN-726 submarines to experience less churn than FFG-7 ships. Since both programs use similar COSAL models and are therefore equally affected by changes to the MDF, PSI and other allowance computation related files it follows that any differences must be due to differences in configuration management.

Appendix P compares contractor furnished ISNSL deletions between SSBN-726 and FFG-7 shipbuilding programs. This analysis suggests no statistically significant differences in the levels of ISNSL churn between shipbuilding programs (see Tables 139 and 141 of Appendix P). Based on these

results it appears ISNSL churn is more closely related to data changes within the MDF and PSI (including the annual BRF update) than configuration adjustments.

## F. ISNSL CHURN DEPTH

All prior analysis of ISNSL allowance data considered only range additions and deletions. The issue of allowance addition and deletion depth was not included. The purpose of this section is to describe and discuss the impact of depth on ISNSL churn and ISNSL deletions in particular.

Range is a measure of the number of different items of supply in an inventory. Depth is a measure of the total number of items of supply in an inventory. For example, your silverware drawer may have a range of three items (knife, fork, and spoon) and a depth of twenty-four items (eight knives, forks and spoons).

ISNSL allowance adjustments (additions or deletions) can affect either range or depth. Range additions indicate the computation of a repair part for stockage that previously did not compute for stockage. Depth additions add more of the same item to a ship's support inventory. Allowance item range and depth additions result from configuration additions (adding new equipment to a Weapons System File) or changes to the MDF/PSI which affect item computation. Range deletions remove all items of a particular type from

allowance. Depth deletions remove only some items of a particular type from allowance.

An understanding of ISNSL deletions from a range and depth point of view may be helpful in determining the cause of excess allowance materials during the ship outfitting period. Table 16 summarizes the FFG-57's 2nd ISNSL allowance deletions. The "Total Range of Items Deleted" represents the number of different NSNs deleted, either in range or depth on the ISNSL. The "Total Depth of Items Deleted" is the total number of items deleted from stockage by the ISNSL. The "Number of Range Deletes" represents the NSNs which were entirely deleted from stockage (reduced to a zero quantity). The "Number of Depth Deletes" is the number of NSNs which decreased in allowance quantity (e.g., a reduction from a stockage level of 5 to a stockage level of 4).

Perhaps the most significant point about FFG-57's 2nd ISNSL is that over half the deletions involve depth only. In other words, over half the time ISNSL deletions involve decreasing the quantity of an existing allowance item rather than removing the item completely from onboard inventories. This suggests that the deleted items remain applicable to installed equipment and the reasons for deletion are either equipment population reductions or changes to computation related data elements within the MDF or PSI. Minor depth

TABLE 16
FFG-57 SECOND ISNSL ALLOWANCE DELETIONS

Contractor Furnished Material Deletes

| | |
|---|---|
| Total Range of Items Deleted | 628 |
| Total Depth of Items Deleted | 1231 |
| Number of Range Deletes | 283 |
| Number of Depth Deletes | 345 |
| Number of Deletes Involving a Quantity of 1 (Range or Depth) | 474 |
| Total Number of Navy Cog Affected | 47 |
| Total Number of DLA Cog Affected | 581 |
| Items Less Than $10.00 each | 349 |
| Items Between $10.00 and $1000.00 each | 270 |
| Items Greater Than $1000.00 each | 9 |

Government Furnished Material Deletes

| | |
|---|---|
| Total Range of Items Deleted | 2094 |
| Total Depth of Items Deleted | 4700 |
| Number of Range Deletes | 994 |
| Number of Depth Deletes | 1100 |
| Number of Deletes Involving a Quantity of 1 (Range or Depth) | 1565 |
| Total Number of Navy Cog Affected | 242 |
| Total Number of DLA Cog Affected | 1852 |
| Items Less Than $10.00 each | 662 |
| Items Between $10.00 and $1000.00 each | 1329 |
| Items Greater Than $1000.00 each | 103 |

decreases for items with continued onboard application suggests that the ISNSL process may be too sensitive to small adjustments to the MDF and PSI.

An additional consideration regarding depth deletions involves the notion of item application. Clearly, if an allowance item is being deleted in depth only, it still has application to an installed equipment. In the absence of changes to equipment maintenance strategies or erroneous configuration accounting, it seems logical to leave support material onboard once it has computed for allowance rather

than adjust the allowance document, cancel orders and place received material in excess.

An analysis of ISNSL depth additions has similar results. That is, many allowance additions are depth increases only. However, most Project Managers are not as concerned with adding support material onboard ships as they are with removing allowance material which has already been requisitioned from the supply system or bought by the shipbuilder.

It appears that most ISNSL churn involves minor changes to allowance depth quantities. Depth and range changes result from both configuration adjustments and changes to inventory management data in the MDF, PSI, etc. However, allowance depth changes alone, do not generally result from the total deletion of an equipment from a ship's configuration index. On the other hand, range changes are more closely associated with the addition or deletion of an equipment from a ship's WSF configuration. Viewing ISNSL churn from this perspective may provide insight into the accumulation of excess outfitting material and suggest possible corrective action.

## G. ADMINISTRATIVE ISNSL CHURN VS EXCESS MATERIAL

ISNSL allowance deletions don't necessarily result in excess materials. In some sense, excess material is a subset of ISNSL allowance deletions. Inspection of SSBN-726

and FFG-7 class ISNSL deletion statistics reveals a tremendous dollar value and item count in deleted allowance material during the allowance development period. For all ISNSL deletions to result in excess material, each allowance item authorized on an ISNSL would have to be ordered and shipped prior to computation of the next ISNSL. Obviously not all allowance material is ordered and shipped prior to computation of the next ISNSL.

ISNSL allowance addition and deletion statistics are also referred to as "Administrative Churn". Administrative churn represents all the changes to a ship's ISNSL allowance during the outfitting period. Administrative churn reflects the effort needed by the outfitting activity to order, cancel, receive, bin or adjust a ship's support material allowance.

The dollar value and item count of ISNSL allowance deletions is significant but can be misleading. The FFG-57's second ISNSL identified 2600 deletions with a total value exceeding two million dollars. Of these deletes, 1% or 27 items represented 79% (1.6 million dollars) of the dollar value, while 85% of the deleted items cost less than $100.00 each. Most high dollar value items were not issued to the outfitting activity by the supply system prior to issuance of the next ISNSL.

ISNSL allowance deletes do not equate to excess outfitting materials for a number of reasons. For many

items, particularly high cost repairables managed by SPCC, ISNSL deletes are successfully canceled prior to material shipment. The outfitting requisitions for high value/short supply repairable components are often backordered by the Inventory Control Point until the ship is close to completion and delivery.

A high dollar value filter of all allowance items is performed by the ISNSL program. This filter passes allowance item characteristics through a decision table to identify items with unusually high prices or large allowance quantities. The parameters of the decision table are set by FMSO based on guidance from NAVSUP and NAVSEA. The settings distinguish between consumable and repairable items. Consumable item settings are; 1) an allowance quantity greater than 20, 2) a unit price greater than $200 or 3) an extended price greater than $1200. Repairable item settings are; 1) an allowance quantity greater than 10, 2) a unit price greater than $1000 or 3) an extended price greater than $2000. [Ref. 16]

The ISNSL program produces a high dollar value listing which is reviewed by the Naval Sea Logistic Support Engineering Activity (NAVSEALOGSUPENGACT) after each ISNSL computation and before material is requisitioned. Many high cost items are caught by this process and never ordered. However, the ISNSL program reflects filtered item adjustments as a delete on subsequent allowance documents.

Finally, the ISNSL program contains a residual asset application routine which matches excess material from previous new construction ships against current ISNSL requirements. This application reuses excess materials from early shipbuilding.

ISNSL allowance deletion or administrative churn potentially causes excess outfitting materials. Most high cost items are prevented from becoming excess outfitting assets by performing management reviews of ISNSL allowances prior to placing material on order, by requisition processing policies at the ICPs, by guidance to outfitting activities from Program Managers and by excess asset application routines. However, in spite of efforts to reduce excess materials significant amounts of residual asset continue to accumulate.

## H. SUMMARY

This chapter has looked at the ISNSL churn statistics from SSBN-726 class submarines and FFG-7 class surface ships in an effort to identify factors contributing to excess outfitting materials. A series of statistical tests were conducted on this data to determine the relationships between ISNSL churn, configuration changes and annual BRF updating. Correlation, regression and mean comparisons were the primary statistical tools of the analysis. Regression and correlation analysis indicated no consistently strong

relationship between ISNSL churn and configuration changes or BRF updating.

Comparing the average churn between ISNSL's affected by annual BRF updating to those not affected by BRF updating generally indicated that the annual BRF adjustments resulted in substantially higher churn. The composition of ISNSL adjustments, distinction between range and depth and the impact of these adjustment on overall support was reviewed. The distinction between ISNSL churn statistics or "Administrative Churn" and actual excess materials was discussed.

The purpose of the research and analysis in this chapter has been descriptive rather than predictive in nature. The factors and variables that affect ISNSL/COSAL allowance computation are numerous and varied. A ship's Weapons System File configuration index is changing almost daily.

The MDF and PSI are exceptionally dynamic files. The MDF alone receives 750,000 to 1.5 million changes each month. An appreciation of the complexity and intricacy of the allowance development process is needed before an attempt to suggest improvements, enhancements or alternative procedures can be made.

# V. CONCLUSIONS AND RECOMMENDATIONS

Over the last several years, the Navy has recognized that large volumes of excess spares and repair parts result from Ship Construction Navy (SCN) shipbuilding programs. Increased awareness and concern over Department of Defense spare parts procurement and management practices have provided an environment in which the SCN allowance development processes requires scrutiny. The purpose of this final chapter is to offer some conclusions and recommendations arising from the research.

## A. CONCLUSIONS

The primary conclusions arising from this research are offered in the next few paragraphs. Supporting conclusions may be drawn from the preceding chapters.

### 1. SCN Allowance Development and Outfitting Process

Throughout this research the complexity of the procurement, provisioning and allowance development processes has been discussed. The business of building and outfitting sophisticated weapon systems is neither simple nor sequential. The procedures and programs which support this process are equally complex and any efforts to modify this system must be approached in a cautious and systematic manner.

2. Excess Outfitting Materials

The accumulation of excess outfitting materials is a substantial problem for NAVSEA managed shipbuilding programs. Although many excesses originate in the ISNSL program, evidence suggests that there are other contributing factors. One cause of excess outfitting material not directly related to the ISNSL process are Type III spares sent to the outfitting activity to support government furnished equipment. Type III spares apply to government furnished equipment supported by the equipment's manufacturer. This method of support is used for new equipment which has not completed the provisioning process.

3. ISNSL Churn

The causes of ISNSL churn are difficult to isolate for two reasons. First, the files involved in ship allowance computation (WSF, MDF, and PSI etc.) are tremendously volatile. Although modification and access to the WSF for new ship's is restricted to the Ship Acquisition Project Manager (SHAPM) or designated reporting activities, a large volume of configuration records are established, modified or deleted over the outfitting period. The MDF and PSI experience an average of between 750,000 and 1.5 million maintenance transactions monthly.

Secondly, the computation models used by the ISNSL process consider multiple variables. As these variables change independently it becomes increasingly difficult to

determine the cause of ISNSL allowance additions or deletions without considering each item of supply individually.

For the purpose of this research, consideration of the causes of ISNSL churn have been limited to configuration changes and annual Best Replacement Factor adjustments. With configuration changes, ISNSL deletions occur due to changes in the ship's configuration index within the WSF Level A between ISNSLs. These configuration changes may be due to equipment additions, change outs, removals, validation results or correction of reporting errors.

BRF changes are a subset of the changes to the MDF, PSI and WSF Level C. These changes are related to spare and repair parts and include price, maintenance code, note code and unit of issue changes in additions to BRF modification.

4. Configuration and ISNSL Churn

The analysis of ISNSL data on SSBN-726 and FFG-7 classes was largely inconclusive regarding the relationship between ISNSL churn and configuration changes during the allowance development period. Common sense and intuition suggests that excessive configuration reporting errors would result in greater ISNSL churn since erroneous configuration records and associated parts support would require removal from affected stockage allowances. However, there is no statistically significant evidence pointing towards frequent configuration reporting errors of this type.

Although both the SSBN-726 and the FFG-7 programs use FOMIS to build WSF configuration, there are noteworthy differences. First, SSBN-726 FOMIS reporting is done by a single activity for all types of equipment. FFG-7 class FOMIS configuration reporting responsibilities are divided among four activities. The three FFG-7 shipyard supervisors report contractor furnished (CF) configuration while the project manager centrally reports all government furnished (GF) equipment configuration.

Secondly, the standardization and management controls placed on the SSBN-726 program (because of it's strategic importance) are more rigid than those used in the FFG-7 program. Given the greater configuration control in the SSBN-726 program, there is no evidence that SSBN-726 class submarines experience less ISNSL churn than FFG-7s.

5. <u>Best Replacement Factor (BRF) and ISNSL Churn</u>

In every COSAL computation model currently in use, except nuclear support models, the Best Replacement Factor (BRF) is a critical determinant of allowance item computations. Once again, intuition would suggest that changing item BRFs between ISNSL computations would result in greater allowance adjustments than if BRF were to remain fixed. All ISNSL data analyzed for this research suggests that BRF and ISNSL churn are related. Fourth Flight FFG-7 class data indicates in a rather convincing manner that annual BRF updating results in significant increases in

ISNSL churn. In some cases this was twice as much ISNSL churn. It appears that any effort to reduce ISNSL churn and resulting excess outfitting assets must address the manner in which the Best Replacement Factor is adjusted or used by the ISNSL process.

## B. RECOMMENDATIONS

The primary emphasis throughout this thesis has been to investigate SCN shipbuilding program allowance list development procedures and the excess allowance materials resulting from the outfitting process. This emphasis has included an investigation of the ISNSL process and supporting programs. The following recommendations fall into two categories; symptomatic recommendations and system recommendations.

### 1. Symptomatic Recommendations

The following recommendations address areas external to the ISNSL/COSAL allowance development process. Given that a certain amount of residual or "left over" material may be an undesired, but necessary, part of the initial outfitting business, these recommendations concern ways to avoid or manage excesses better.

#### a. Deferred Requisitioning

Implement existing COSAL deferred requisitioning procedures on SCN initial outfitting requisitions. Deferred requisitioning procedures code each material order with a

future required delivery date (RDD). The deferred requisitioning program was developed to prevent the unplanned drawdown of wholesale supply system assets by retail activities (ships) subsequent to allowance document changes. Under the deferred concept the Inventory Control Point (ICP) suspends material issue for initial outfitting requirements for the lesser of a material procurement lead time or the required delivery date.

Implementing deferred requisitioning procedures for SCN outfitting material would allow the ICP visibility of initial allowance requirements for procurement purposes, maintain wholesale supply system inventories for forecasted recurring demand and prevent premature material issue early in the outfitting cycle. (Requirements which may subsequently be canceled by future ISNSL computations.)

b. Automated ISNSL Processing

Most NAVSEA field activities process ISNSL products manually. The administrative costs and lost time involved with handling thousands of ISNSL punched cards and listings by hand is high but difficult to quantify. Above the costs of residual materials caused by excessive ISNSL churn is the administrative costs of ordering and canceling material throughout the supply system. Developing a standard automated ISNSL processing system and eliminating punched cards and reams of listings would significantly enhance the SCN outfitting process.

c. BRF Update Methods and ISNSL Program Interface

The manner in which Best Replacement Factors are updated has been under review for some time. In the past, BRFs have been annually adjusted using a weighted average technique. This method was thought to be too sensitive to the previous years' usage data and had a tendency to change BRFs unnecessarily (it usually lowered them). After completion of a BRF Study by the Fleet Material Support Office in 1983, a revised BRF adjustment technique using a ratio computation was recommended.

The BRF's impact on ISNSL churn is but one consideration in determining preferred method of BRF updating. A decision on BRF updating has been deferred pending additional study on the effects of each method of update on COSAL effectiveness, cost and fleet readiness. If the BRF remains a volatile data element, then the manner in which the ISNSL process uses BRF data should be reviewed.

d. Standardized/Centralized Residual Asset Management

Each major shipbuilding program handles excess outfitting materials differently. Within shipbuilding programs, excess assets "owned" by one program manager are not easily visible to other program managers for application to outfitting requirements. Not all shipbuilding programs participate in the ISNSL residual asset application routine. The inventory management resources and techniques applied to

excess assets is limited and duplicative in nature. Given that a certain amount of excess material is inherent to the SCN allowance development process, economies of scale and increased reuse of residual assets may be achievable with standard and centralized excess asset management.

e. Minimize ISNSLs

The SSBN-726 class submarine program currently runs two ISNSL computations during initial allowance development. The number of ISNSL computations needed to develop adequate supply support is a function of a number of factors, including equipment provisioning and configuration development progress. To the extent that these processes can be expedited and the number of ISNSLs reduced, ISNSL churn related excess materials will decrease.

2. <u>Systems Recommendations</u>

In contrast to symptomatic recommendations, systems recommendations address areas within the ISNSL allowance development process. The primary systems recommendation involves a review of the ISNSL programs to reduce sensitivity to configuration and non-configuration files changes. The purpose of the ISNSL process is to develop initial supply support. That support is designed to achieve the highest degree of equipment readiness consistent with funding and maintenance strategy considerations. The continual churning of allowance items during the outfitting period does not aid in achieving this goal.

In the past, computer capacity and software constraints have prohibited redesign of many UICP programs, including the ISNSL. Major hardware upgrades at SPCC along with comprehensive software resystemization will permit substantial program redesign in the future. Success in redesigning the ISNSL program hinges on the ability of it's users to articulate existing systems shortcomings accurately and recommend needed enhancements. The following recommendations outline several alternative improvements to the ISNSL process.

a. ISNSL Allowance Protection

Develop a method to protect allowance items from subsequent ISNSL deletion if the repair part remains applicable to installed equipment. Once an item computes for allowance and is requisitioned from the supply system or bought by the shipbuilder, it makes little sense to remove it from the ship because of minor fluctuations in BRF, price or other factors. If an item computed for allowance at one time, remains applicable to installed equipment, and has been ordered and/or received at the shipyard it seems both logical and beneficial to stock the item.

b. Exception Coding

Develop an exception coding system for all ISNSL additions and deletions to provide statistical data on what caused ISNSL churn and the equipment associated with the churn. This would allow research of allowance adjustments,

prevent erroneous orders or cancellations, permit trend analysis and identify problem areas.

c. Inhibit Depth Churn

Once an item has computed for allowance in a specified quantity, suppress routine depth additions and deletions unless additional information suggests an adjustment is required. The SSBN-726 program has implemented this concept in Trident submarine COSAL maintenance. Basically, each Trident submarine receives a new allowance document quarterly. This document is known as a Trident COSAL work package.

Although the Trident COSAL maintenance program is currently labor intensive, it has some features which may be beneficial to traditional allowance development procedures. The Trident COSAL maintenance process matches a submarine's current WSF configuration with the last COSAL and identifies new equipment additions and deletions. From these equipment changes an allowance item addition and deletion candidate listing is developed. The candidate listing is then compared with the submarine's current allowance list to determine needed adjustments. As a general rule, only range additions and deletions are made during this process. An allowance addition candidate already onboard or an allowance deletion candidate with remaining application will be suppressed from maintenance action.

d. Control UICP Files Maintenance

Develop MDF and PSI control mechanisms for allowance computation sensitive data elements. Currently many data elements within the MDF and PSI are subject to modification by ICP without management control or audit trails. Data elements like the BRF have significant impact on the level of support received afloat. The ability to manually adjust BRFs for short term requirements is not in the best interests of the supply system or fleet readiness. An adequate methodology needs to be developed to monitor files maintenance actions and prevent inappropriate changes without unnecessarily reducing systems flexibility and responsiveness.

APPENDIX A

# SSBN-726 CORRELATION AND REGRESSION ANALYSIS

TABLE 17
SSBN-726 REGRESSION AND CORRELATION DATA

| Hull | ISNSL | Independent Variables: Config Range | Config Depth | BRF Update | Dependent Variables: Adds | Deletes | Total Churn |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 53 | 264 | 1 | 3104 | 2655 | 5759 |
| 727 | 3 | 84 | 380 | 0 | 1006 | 2458 | 3464 |
| 727 | 4 | 32 | 392 | 0 | 1298 | 618 | 1916 |
| 727 | 5 | 0 | 113 | 1 | 1971 | 2551 | 4522 |
| 727 | 6 | 14 | 282 | 0 | 2325 | 1205 | 3530 |
| 729 | 2 | 52 | 224 | 1 | 2454 | 2194 | 4648 |
| 729 | 3 | 370 | 433 | 0 | 2382 | 1065 | 3447 |
| 730 | 2 | 223 | 2867 | 0 | 3025 | 2022 | 5047 |
| 730 | 3 | 386 | 381 | 1 | 4542 | 1984 | 6526 |
| 731 | 2 | 9 | 330 | 0 | 1272 | 1015 | 2287 |
| 731 | 3 | 68 | 135 | 1 | 2062 | 2144 | 4206 |
| 733 | 2 | 300 | 993 | 1 | 7768 | 6945 | 14713 |

TABLE 18
SSBN-726 CORRELATION TABLE

| | Config Range | Config Depth | Adds | Deletes | Adds+ Deletes |
|---|---|---|---|---|---|
| Config Depth | 0.354 | | | | |
| Adds | 0.623 | 0.272 | | | |
| Deletes | 0.302 | 0.171 | 0.840 | | |
| Adds+Deletes | 0.492 | 0.234 | 0.964 | 0.954 | |
| BRF Update | 0.076 | -0.295 | 0.500 | 0.539 | 0.540 |

TABLE 19

SSBN ISNSL ALLOWANCE ADDITIONS VS ALLOWANCE DELETIONS

T TEST AND ANALYSI OF VARIANCE

ISNSL Adds vs ISNSL Deletes T Test

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| ISNSL Adds | 12 | 2767 | 1844 | 532 |
| ISNSL Deletes | 12 | 2238 | 1628 | 470 |

95 PCT CI FOR MU ISNSL Adds - MU ISNSL Deletes: (-948, 2007)
TTEST MU ISNSL Adds = MU ISNSL Deletes (VS NE): T=0.75
P=0.46 DF=21.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 1681691 | 1681691 | 0.56 |
| ERROR | 22 | 66568176 | 3025826 | |
| TOTAL | 23 | 68249856 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
LEVEL              N   MEAN   STDEV  --+--------+--------+--------+-
ISNSL Adds        12   2767    1844      (------------*------------)
ISNSL Deletes     12   2238    1628  (----------*----------)
                                      -+--------+--------+--------+-
POOLED STDEV =     1739             1500     2250     3000     3750
```

TABLE 20
SSBN-726 ISNSL ALLOWANCE ADDITIONS
MULTIPLE LINEAR REGRESSION

The regression equation is:

ISNSL Adds = 638 + 6.21(Config Range) + 0.626(Config Depth)
+ 1902(BRF Update Indicator)

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 638.1 | 694.8 | 0.92 |
| Config Range | 6.215 | 2.913 | 2.13 |
| Config Depth | 0.6256 | 0.5836 | 1.07 |
| BRF Update | 1902.3 | 795.2 | 2.39 |

s = 1289 R-sq = 64.5%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 3 | 24121280 | 8040426 |
| Error | 8 | 13285778 | 1660722 |
| Total | 11 | 37407056 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| Config Range | 1 | 14502616 |
| Config Depth | 1 | 113409 |
| BRF Update | 1 | 9505259 |

TABLE 21
SSBN-726 ISNSL ALLOWANCE DELETIONS
MULTIPLE LINEAR REGRESSION

The regression equation is:

ISNSL Deletes = 690 + 1.66(Config Range)
+ 0.646(Config Depth) + 1924(BRF Update Indicator)

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 690.5 | 777.8 | 0.89 |
| Config Range | 1.657 | 3.261 | 0.51 |
| Config Depth | 0.6462 | 0.6533 | 0.99 |
| BRF Update | 1923.8 | 890.1 | 2.16 |

s = 1443    R-sq = 42.9%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 3 | 12512645 | 4170881 |
| Error | 8 | 16648552 | 2081069 |
| Total | 11 | 29161184 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| Config Range | 1 | 2652620 |
| Config Depth | 1 | 138774 |
| BRF Update | 1 | 9721251 |

## APPENDIX B

## SSBN-726 ISNSL ALLOWANCE ADDITIONS

TABLE 22
SSBN-726 GF SRI AND GF OSI ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | GF/SRI Allw | GF/SRI Adds | GF/SRI Adds % | GF/OSI Allw | GF/OSI Adds | GF/OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 4535 | 1428 | 31.4884 | 2204 | 494 | 22.4138 |
| 727 | 3 | 3332 | 411 | 12.3349 | 2193 | 51 | 2.3256 |
| 727 | 4 | 3480 | 359 | 10.3161 | 2163 | 172 | 7.9519 |
| 727 | 5 | 3527 | 653 | 18.5143 | 2275 | 339 | 14.9011 |
| 727 | 6 | 3885 | 1011 | 26.0231 | 2580 | 442 | 17.1318 |
| 729 | 2 | 4265 | 955 | 22.3916 | 3113 | 435 | 13.9737 |
| 729 | 3 | 4310 | 445 | 10.3248 | 3074 | 177 | 5.7580 |
| 730 | 2 | 3733 | 1318 | 35.3067 | 2650 | 1233 | 46.5283 |
| 730 | 3 | 4339 | 1309 | 30.1682 | 3246 | 1088 | 33.5182 |
| 731 | 2 | 4054 | 173 | 4.2674 | 3182 | 173 | 5.4368 |
| 731 | 3 | 4299 | 532 | 12.3750 | 2653 | 251 | 9.4610 |
| 733 | 2 | 4258 | 3499 | 82.1747 | 3209 | 2184 | 68.0586 |

```
      .    ::    .  .  .   ..   .                                   .
+---------+---------+---------+---------+---------+--------
                 GF SRI Allowance Adds

. :..   ...    .      .        .             .
+---------+---------+---------+---------+---------+--------
0.00     15.00     30.00     45.00     60.00     75.00
                 GF OSI Allowance Adds
```

Figure 9. SSBN-726 GF SRI vs GF OSI ISNSL Allowance Additions Dotplot

TABLE 23
SSBN-726 GF SRI VS GF OSI ISNSL ALLOWANCE ADDITIONS T TEST
AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds vs CF SRI Adds

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 12 | 24.6 | 20.6 | 5.9 |
| CF SRI | 12 | 20.6 | 19.7 | 5.7 |

95 PCT CI FOR MU GF SRI Adds - MU GF OSI Adds: (-13.1, 21.1)
TTEST MU GF SRI Adds = MU GF OSI Adds (VS NE): T=0.49 P=0.63
DF=22.0

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 97 | 97 | 0.24 |
| ERROR | 22 | 8924 | 406 | |
| TOTAL | 23 | 9021 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                         BASED ON POOLED STDEV
LEVEL    N    MEAN   STDEV----------+---------+---------+------
GF SRI  12   24.64   20.61       (-------------*-------------)
GF OSI  12   20.62   19.66 (-------------*-------------)
                           ----------+---------+---------+------
POOLED STDEV =  20.14               16.0      24.0      32.0
```

TABLE 24
SSBN-726 CF SRI AND CF OSI ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | CF/SRI Allw | CF/SRI Adds | CF/SRI Adds % | CF/OSI Allw | CF/OSI Adds | CF/OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 6893 | 1088 | 15.7841 | 489 | 94 | 19.2229 |
| 727 | 3 | 7040 | 523 | 7.4290 | 456 | 21 | 4.6053 |
| 727 | 4 | 7200 | 761 | 10.5694 | 377 | 6 | 1.5915 |
| 727 | 5 | 6944 | 886 | 12.7592 | 400 | 93 | 22.2500 |
| 727 | 6 | 7117 | 755 | 10.6084 | 500 | 117 | 23.4000 |
| 729 | 2 | 6353 | 900 | 14.1665 | 633 | 164 | 25.9084 |
| 729 | 3 | 7225 | 1392 | 19.2664 | 935 | 368 | 39.3583 |
| 730 | 2 | 6385 | 454 | 7.1104 | 683 | 174 | 25.4758 |
| 730 | 3 | 7207 | 1778 | 24.6705 | 938 | 366 | 39.0192 |
| 731 | 2 | 7119 | 693 | 9.7345 | 927 | 233 | 25.1348 |
| 731 | 3 | 7193 | 977 | 13.5826 | 935 | 302 | 32.2995 |
| 733 | 2 | 6996 | 1953 | 27.9159 | 1004 | 162 | 16.1355 |

```
        ..  .:  ...  .     .      .    .
-------+---------+---------+---------+---------+---------
                        CF SRI Adds
.   .               .   .     :  :.        .         :
-------+---------+---------+---------+---------+---------
      7.00     14.00     21.00     28.00     35.00
                        CF OSI Adds
```

Figure 10. SSBN-726 CF SRI vs CF OSI ISNSL Allowance Additions Dotplot

TABLE 25
SSBN-726 CF SRI VS CF OSI ISNSL ALLOWANCE ADDITIONS
T TEST AND ANALYSIS OF VARIANCE

T Test for CF SRI Adds vs CF OSI Adds

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI | 12 | 14.47 | 6.53 | 1.9 |
| CF OSI | 12 | 23.0 | 11.6 | 3.4 |

95 PCT CI FOR MU CF SRI - MU CF OSI: (-16.6, -0.4)
TTEST MU CF SRI = MU CF OSI (VS NE): T=-2.20 P=0.042 DF=17.3

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 431.8 | 431.8 | 4.85 |
| ERROR | 22 | 1957.8 | 89.0 | |
| TOTAL | 23 | 2389.6 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL      N    MEAN    STDEV  --+---------+---------+---------+
CF SRI    12  14.466   6.534  (-------*--------)
CF OSI    12  22.950  11.631              (---------*---------)
                               --+---------+---------+---------+
POOLED STDEV = 9.433          12.0      18.0      24.0      30.0
```

TABLE 26
SSBN-726 GF AND CF SRI ISNSL ALLOWANCE ADDITION PERCENTAGES

| Hull | ISNSL | GF SRI Adds % | CF SRI Adds % |
|---|---|---|---|
| 727 | 2 | 31.4884 | 15.7841 |
| 727 | 3 | 12.3349 | 7.4290 |
| 727 | 4 | 10.3161 | 10.5694 |
| 727 | 5 | 18.5143 | 12.7592 |
| 727 | 6 | 26.0231 | 10.6084 |
| 729 | 2 | 22.3916 | 14.1665 |
| 729 | 3 | 10.3248 | 19.2664 |
| 730 | 2 | 35.3067 | 7.1104 |
| 730 | 3 | 30.1682 | 24.6705 |
| 731 | 2 | 4.2674 | 9.7345 |
| 731 | 3 | 12.3750 | 13.5826 |
| 733 | 2 | 82.1747 | 27.9159 |

```
  .   ::   .  . .  ..  .                              .
+---------+---------+---------+---------+---------+-------
                       GF SRI Adds
                   .
    :.: : . .  .  .
+---------+---------+---------+---------+---------+-------
0.00     15.00     30.00     45.00     60.00     75.00
                       CF SRI Adds
```

Figure 11. SSBN-726 GF SRI vs CF SRI ISNSL Allowance Additions Dotplot

TABLE 27
SSBN-726 GF SRI vs CF SRI ISNSL ALLOWANCE ADDITIONS
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds vs CF SRI Adds

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 12 | 24.6 | 20.6 | 5.9 |
| CF SRI | 12 | 14.47 | 6.53 | 1.9 |

95 PCT CI FOR MU GF SRI Adds - MU CF SRI Adds: (-3.3, 23.7)
TTEST MU GF SRI Adds = MU CF SRI Adds (VS NE): T=1.63 P=0.13
DF=13.2

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 621 | 621 | 2.66 |
| ERROR | 22 | 5143 | 234 | |
| TOTAL | 23 | 5764 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                     BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV  ---+---------+---------+---------+--
GF SRI   12   24.64   20.61             (-----------*----------)
CF SRI   12   14.47    6.53    (----------*-----------)
                             ---+---------+---------+---------+--
POOLED STDEV = 15.29           8.0      16.0      24.0      32.0
```

TABLE 28
SSBN-726 GF OSI AND CF OSI ISNSL ALLOWANCE ADDITION
PERCENTAGES

| Hull | ISNSL | GF OSI Adds % | CF OSI Adds % |
|---|---|---|---|
| 727 | 2 | 22.4138 | 19.2229 |
| 727 | 3 | 2.3256 | 4.6053 |
| 727 | 4 | 7.9519 | 1.5915 |
| 727 | 5 | 14.9011 | 23.2500 |
| 727 | 6 | 17.1318 | 23.4000 |
| 729 | 2 | 13.9737 | 25.9084 |
| 729 | 3 | 5.7580 | 39.3583 |
| 730 | 2 | 46.5283 | 25.4758 |
| 730 | 3 | 33.5182 | 39.0192 |
| 731 | 2 | 5.4368 | 25.1348 |
| 731 | 3 | 9.4610 | 32.2995 |
| 733 | 2 | 68.0586 | 16.1355 |

```
 . :..  ...   .       .        .              .
+---------+---------+---------+---------+---------+-------
                      GF OSI Adds

                .
 .       . . ..:    .   :
+---------+---------+---------+---------+---------+-------
0.00     15.00     30.00     45.00     60.00     75.00
                      CF OSI Adds
```

Figure 12. SSBN-726 GF OSI vs CF OSI ISNSL Allowance Additions Dotplot

```
               T Test for GF OSI Adds vs CF OSI Adds

            N       MEAN      STDEV   SE MEAN
GF OSI     12       20.6       19.7       5.7
CF OSI     12       23.0       11.6       3.4

95 PCT CI FOR MU GF OSI - MU CF OSI: (-16.2, 11.6)
TTEST MU GF OSI = MU GF OSI (VS NE): T=-0.35 P=0.73 DF=17.9

                     Analysis of Variance

SOURCE      DF         SS         MS        F
FACTOR       1         33         33     0.12
ERROR       22       5739        261
TOTAL       23       5772
                               INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL      N    MEAN   STDEV  +---------+---------+---------+---
GF OSI    12   20.62   19.66 (----------------*----------------)
CF OSI    12   22.95   11.63    (--------------*--------------)
                              +--------+---------+---------+----
POOLED STDEV = 16.15     12.0       18.0      24.0      30.0
```

TABLE 29
SSBN-726 GF OSI VS GF OSI ISNSL ALLOWANCE ADDITIONS
T TEST AND ANALYSIS OF VARIANCE

# APPENDIX C

## SSBN-726 ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

TABLE 30
SSBN-726 GF ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE A FACTOR

| Hull | ISNSL | GF SRI Allw | GF SRI Adds | GF SRI Adds % | GF OSI Allw | GF OSI Adds | GF OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 4535 | 1428 | 31.4884 | 2209 | 494 | 22.3631 |
| 727 | 5 | 3527 | 653 | 18.5143 | 2275 | 339 | 14.9011 |
| 729 | 2 | 4265 | 955 | 22.3916 | 3113 | 435 | 13.9737 |
| 730 | 3 | 4339 | 1309 | 30.1682 | 3246 | 1088 | 33.5182 |
| 731 | 3 | 4299 | 532 | 12.3750 | 2653 | 251 | 9.4610 |
| 733 | 2 | 4258 | 3499 | 82.1747 | 3209 | 2184 | 68.0586 |

```
          .    .   .      ..                                             .
-------+---------+---------+---------+---------+---------
                          GF SRI Adds
     .   ..     .      .                   .
-------+---------+---------+---------+---------+---------
     15.00     30.00     45.00     60.00     75.00
                          GF OSI Adds
```

Figure 13. SSBN-726 ISNSL GF SRI vs OSI Allowance Additions Dotplot Annual BRF Update a Factor

TABLE 31
SSBN-726 GF SRI VS GF OSI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI VS GF OSI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 6 | 32.9 | 25.2 | 10 |
| GF OSI | 6 | 27.0 | 21.8 | 8.9 |

95 PCT CI FOR MU GF SRI - MU GF OSI: (-25, 36.6)
TTEST MU GF SRI = MU GF OSI (VS NE): T=0.43 P=0.68 DF=9.8

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 101 | 101 | 0.18 |
| ERROR | 10 | 5550 | 555 | |
| TOTAL | 11 | 5651 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL     N    MEAN    STDEV  -----+---------+---------+---------+
GF SRI    6   32.85    25.20     (-------------*--------------)
GF OSI    6   27.05    21.79(--------------*--------------)
                              -----+---------+---------+---------+
POOLED STDEV = 23.56              14        28        42        56
```

TABLE 32
SSBN-726 CF ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE A FACTOR

| HULL | ISNSL | CF SRI Allw | CF SRI Adds | CF SRI Adds% | CF OSI Allw | CF OSI Adds | CF OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 6893 | 1088 | 15.7841 | 489 | 94 | 19.2229 |
| 727 | 5 | 6944 | 886 | 12.7592 | 400 | 93 | 23.2500 |
| 729 | 2 | 6353 | 900 | 14.1665 | 633 | 164 | 25.9084 |
| 730 | 3 | 7207 | 1778 | 24.6705 | 938 | 366 | 39.0192 |
| 731 | 3 | 7193 | 977 | 13.5826 | 935 | 302 | 32.2995 |
| 733 | 2 | 6996 | 1953 | 27.9159 | 1004 | 162 | 16.1355 |

```
  . . .   .                          .         .
-------+---------+---------+---------+---------+--------
                        CF SRI Adds
             .       .        .      .           .           .
-------+---------+---------+---------+---------+--------
     15.00     20.00     25.00     30.00     35.00
                         CF OSI Adds
```

Figure 14. SSBN-726 CF SRI vs CF OSI ISNSL Allowance Additions Dotplot Annual BRF Update a Factor

TABLE 33
SSBN-726 CF SRI VS CF OSI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATING CONSIDERED A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for CF SRI VS CF OSI

| | N | MEAN | STDEV`A | SE MEAN |
|---|---|---|---|---|
| CF SRI | 6 | 18.15 | 6.47 | 2.6 |
| CF OSI | 6 | 25.97 | 8.49 | 3.5 |

95 PCT CI FOR MU CF SRI - MU CF OSI: (-17.7, 2.0)
TTEST MU CF SRI = MU CF OSI (VS NE): T=-1.80 P=0.11 DF=9.3

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 183.7 | 183.7 | 3.23 |
| ERROR | 10 | 569.3 | 56.9 | |
| TOTAL | 11 | 753.0 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL     N     MEAN   STDEV  +---------+---------+---------+----
CF SRI    6   18.146   6.470(-----------*-----------)
CF OSI    6   25.973   8.485             (-----------*-----------)
                              +---------+---------+---------+----
POOLED STDEV = 7.545        12.0      18.0      24.0      30.0
```

TABLE 34
SSBN-726 GF ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE NOT A FACTOR

| Hull | ISNSL | GF SRI Allw | GF SRI Adds | GF SRI Adds % | GF OSI Allw | GF OSI Adds | GF OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 3 | 3332 | 411 | 12.3349 | 2193 | 51 | 2.3256 |
| 727 | 4 | 3480 | 359 | 10.3161 | 2163 | 172 | 7.9519 |
| 727 | 6 | 3885 | 1011 | 26.0231 | 2580 | 442 | 17.1318 |
| 729 | 3 | 4310 | 445 | 10.3248 | 3074 | 177 | 5.7580 |
| 730 | 2 | 3733 | 1318 | 35.3067 | 2650 | 1233 | 46.5283 |
| 731 | 2 | 4054 | 173 | 4.2674 | 3182 | 173 | 5.4368 |

```
    .     :  .             .        .
+---------+---------+---------+---------+---------+-------
                        GF SRI Adds
  .  .. .        .                             .
+---------+---------+---------+---------+---------+-------
0.00     10.00     20.00     30.00     40.00     50.00
```

Figure 15. SSBN-726 GF ISNSL Allowance Additions Dotplot
Annual BRF Update a Not Factor

TABLE 35
SSBN-726 GF SRI VS GF OSI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE NOT A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI VS GF OSI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 6 | 16.4 | 11.7 | 4.8 |
| GF OSI | 6 | 14.2 | 16.6 | 6.8 |

95 PCT CI FOR MU GF SRI - MU GF OSI: (-16.9, 21.4)
TTEST MU GF SRI = MU GF OSI (VS NE): T=0.27 P=0.79 DF=9.0

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 15 | 15 | 0.07 |
| ERROR | 10 | 2070 | 207 | |
| TOTAL | 11 | 2085 | | |

```
                                        INDIVIDUAL 95 PCT CI'S FOR MEAN
                                            BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV  --------+---------+---------+-------
GF SRI    6   16.43   11.73    (-------------*--------------)
GF OSI    6   14.19   16.62  (--------------*-------------)
                             --------+---------+---------+-------
POOLED STDEV =   14.39             8.0      16.0      24.0
```

TABLE 36
SSBN-726 CF ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE NOT A FACTOR

| HULL | ISNSL | CF SRI Allw | CF SRI Adds | CF SRI Adds % | CF OSI Allw | CF OSI Adds | CF OSI Adds % |
|---|---|---|---|---|---|---|---|
| 727 | 3 | 7040 | 523 | 7.4290 | 456 | 21 | 4.6053 |
| 727 | 4 | 7200 | 761 | 10.5694 | 377 | 6 | 1.5915 |
| 727 | 6 | 7117 | 755 | 10.6084 | 500 | 117 | 23.4000 |
| 729 | 3 | 7225 | 1392 | 19.2664 | 935 | 368 | 39.3583 |
| 730 | 2 | 6385 | 454 | 7.1104 | 683 | 174 | 25.4758 |
| 731 | 2 | 7119 | 693 | 9.7345 | 927 | 233 | 25.1348 |

```
        ..   .:                   .
-------+---------+---------+---------+---------+--------
                      CF SRI Adds
 .   .                        .  :                   .
-------+---------+---------+---------+---------+--------
     7.00     14.00     21.00     28.00     35.00
                      CF OSI Adds
```

Figure 16. SSBN-726 CF SRI vs CF OSI ISNSL Allowance Additions Dotplot Annual BRF Update a Not Factor

TABLE 37
SSBN-726 CF SRI VS CF OSI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE NOT A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for CF SRI VS CF OSI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI | 6 | 10.79 | 4.42 | 1.8 |
| CF OSI | 6 | 19.9 | 14.3 | 5.8 |

95 PCT CI FOR MU CF SRI - MU CF OSI: (-24.8, 6.5)
TTEST MU CF SRI = MU CF OSI (VS NE): T=-1.50 P=0.19 DF=6.0

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 251 | 251 | 2.25 |
| ERROR | 10 | 1116 | 112 | |
| TOTAL | 11 | 1367 | | |

```
                                INDIVIDUAL 95 PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
LEVEL    N   MEAN    STDEV  -------+---------+---------+-------
CF SRI   6   10.79    4.42  (----------*-----------)
CF OSI   6   19.93   14.27            (-----------*-----------)
                             -------+---------+---------+-------
POOLED STDEV = 10.57              8.0      16.0      24.0
```

TABLE 38
SSBN-726 GF SRI AND CF SRI ISNSL ALLOWANCE ADDITIONS
PERCENTAGES - ANNUAL BRF UPDATE A FACTOR

| HULL | ISNSL | GF SRI Adds % | CF SRI Adds % |
|---|---|---|---|
| 727 | 2 | 31.4884 | 15.7841 |
| 727 | 5 | 18.5143 | 12.7592 |
| 729 | 2 | 22.3916 | 14.1665 |
| 730 | 3 | 30.1682 | 24.6705 |
| 731 | 3 | 12.3750 | 13.5826 |
| 733 | 2 | 82.1747 | 27.9159 |

```
   .   .  .    ..                                 .
-----+---------+---------+---------+---------+---------+-
                        GF SRI Adds
    .
    : .    .  .
-----+---------+---------+---------+---------+---------+-
   15.00     30.00     45.00     60.00     75.00
                         CF SRI Adds
```

Figure 17. SSBN-726 GF SRI vs CF SRI ISNSL Allowance Additions Dotplot Annual BRF Update a Factor

TABLE 39
SSBN-726 GF SRI VS CF SRI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI VS CF SRI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 6 | 32.9 | 25.2 | 10 |
| CF SRI | 6 | 18.15 | 6.47 | 2.6 |

95 PCT CI FOR MU GF SRI - MU CF SRI: (-13, 42.0)
TTEST MU GF SRI = MU CF SRI (VS NE): T=1.38 P=0.22 DF=5.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 649 | 649 | 1.92 |
| ERROR | 10 | 3385 | 339 | |
| TOTAL | 11 | 4034 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                     BASED ON POOLED STDEV
LEVEL    N   MEAN   STDEV   -------+---------+---------+-------
GF SRI   6  32.85   25.20              (----------*-----------)
CF SRI   6  18.15    6.47   (-----------*-----------)
                            -------+---------+---------+-------
POOLED STDEV = 18.40               14        28        42
```

TABLE 40
SSBN-726 GF OSI AND CF OSI ISNSL ALLOWANCE ADDITIONS
PERCENTAGES - ANNUAL BRF UPDATE A FACTOR

| HULL | ISNSL | GF OSI Adds % | CF OSI Adds % |
|---|---|---|---|
| 727 | 2 | 22.3631 | 19.2229 |
| 727 | 5 | 14.9011 | 23.2500 |
| 729 | 2 | 13.9737 | 25.9084 |
| 730 | 3 | 33.5182 | 39.0192 |
| 731 | 3 | 9.4610 | 32.2995 |
| 733 | 2 | 68.0586 | 16.1355 |

```
    .   :       .         .                               .
-----+---------+---------+---------+---------+---------+-
                      GF OSI Adds
         .  .  .  .    .     .
-----+---------+---------+---------+---------+---------+-
   12.00     24.00     36.00     48.00     60.00
                       CF OSI Adds
```

Figure 18. SSBN-726 GF OSI vs CF OSI ISNSL Allowance Additions Dotplot Annual BRF Update a Factor

TABLE 41
SSBN-726 GF OSI VS CF OSI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF OSI VS CF OSI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF OSI | 6 | 27.0 | 21.8 | 8.9 |
| CF OSI | 6 | 25.97 | 8.49 | 3.5 |

95 PCT CI FOR MU GF OSI - MU CF OSI: (-22.3, 24.4)
TTEST MU GF OSI = MU CF OSI (VS NE): T=0.11 P=0.91 DF=6.5

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 3 | 3 | 0.01 |
| ERROR | 10 | 2733 | 273 | |
| TOTAL | 11 | 2737 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL    N    MEAN   STDEV  ---------+---------+---------+------
GF OSI   6   27.05   21.79     (-------------*-------------)
CF OSI   6   25.97    8.49    (-------------*-------------)
                            ---------+---------+---------+------
POOLED STDEV = 16.53                20        30        40
```

TABLE 42
SSBN-726 GF SRI AND CF SRI ISNSL ALLOWANCE ADDITIONS
PERCENTAGES - ANNUAL BRF UPDATE NOT A FACTOR

| HULL | ISNSL | GF SRI Adds % | CF SRI Adds % |
|---|---|---|---|
| 727 | 3 | 12.3349 | 7.4290 |
| 727 | 4 | 10.3161 | 10.5694 |
| 727 | 6 | 26.0231 | 10.6084 |
| 729 | 3 | 10.3248 | 19.2664 |
| 730 | 2 | 35.3067 | 7.1104 |
| 731 | 2 | 4.2674 | 9.7345 |

```
  .         :   .                     .               .
-----+---------+---------+---------+---------+---------+-
                        GF SRI Adds
       :   . :             .
-----+---------+---------+---------+---------+---------+-
    6.00     12.00     18.00     24.00     30.00
                         CF SRI Adds
```

Figure 19. SSBN-726 GF SRI vs CF SRI ISNSL Allowance Additions Dotplot Annual BRF Update Not a Factor

TABLE 43
SSBN-726 GF OSI VS CF SRI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE NOT A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI VS CF SRI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI | 6 | 16.4 | 11.7 | 4.8 |
| CF SRI | 6 | 10.79 | 4.42 | 1.8 |

95 PCT CI FOR MU GF SRI - MU CF SRI: (-6.9, 18.2)
TTEST MU GF SRI = MU CF SRI (VS NE): T=1.10 P=0.31 DF=6.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 95.5 | 95.5 | 1.22 |
| ERROR | 10 | 785.6 | 78.6 | |
| TOTAL | 11 | 881.1 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL     N     MEAN    STDEV   ----+---------+---------+---------+
GF SRI    6   16.429   11.728           (-----------*-----------)
CF SRI    6   10.786    4.425  (-----------*----------)
                                ----+---------+---------+---------+
POOLED STDEV =   8.863              6.0      12.0      18.0      24.0
```

TABLE 44
SSBN-726 GF OSI AND CF OSI ISNSL ALLOWANCE ADDITIONS
PERCENTAGES - ANNUAL BRF UPDATE NOT A FACTOR

| HULL | ISNSL | GF OSI Adds % | CF OSI Adds % |
|---|---|---|---|
| 727 | 3 | 2.3256 | 4.6053 |
| 727 | 4 | 7.9519 | 1.5915 |
| 727 | 6 | 17.1318 | 23.4000 |
| 729 | 3 | 5.7580 | 39.3583 |
| 730 | 2 | 46.5283 | 25.4758 |
| 731 | 2 | 5.4368 | 25.1348 |

```
  .  .. .          .                              .
+---------+---------+---------+---------+---------+-------
                      GF OSI Adds
  .  .                 . :            .
+---------+---------+---------+---------+---------+-------
0.00     10.00     20.00     30.00     40.00     50.00
                      CF OSI Adds
```

Figure 20. SSBN-726 GF OSI vs CF OSI and Allowance Additions Dotplot Annual BRF Update Not a Factor

TABLE 45

SSBN-726 GF OSI VS CF OSI ISNSL ALLOWANCE ADDITIONS
ANNUAL BRF UPDATE NOT A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF OSI VS CF OSI

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF OSI | 6 | 14.2 | 16.6 | 6.8 |
| CF OSI | 6 | 19.9 | 14.3 | 5.8 |

95 PCT CI FOR MU GF OSI - MU CF OSI: (-26.0, 14.5)
TTEST MU GF OSI = MU CF OSI (VS NE): T=-0.64 P=0.54 DF=9.8

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 99 | 99 | 0.41 |
| ERROR | 10 | 2400 | 240 | |
| TOTAL | 11 | 2499 | | |

```
                                      INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
LEVEL    N    MEAN   STDEV  ----------+---------+---------+----
GF OSI   6   14.19   16.62  (-------------*------------)
CF OSI   6   19.93   14.27        (------------*-------------)
                            ----------+---------+---------+----
POOLED STDEV = 15.49                 10        20        30
```

TABLE 46
SSBN-726 GF SRI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update An ISNSL Factor | | | Annual BRF Update Not an ISNSL Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | GF SRI Adds % | HULL | ISNSL | GF SRI Adds % |
| 727 | 2 | 31.4884 | 727 | 3 | 12.3349 |
| 727 | 5 | 18.5143 | 727 | 4 | 10.3161 |
| 729 | 2 | 22.3916 | 727 | 6 | 26.0231 |
| 730 | 3 | 30.1682 | 729 | 3 | 10.3248 |
| 731 | 3 | 12.3750 | 730 | 2 | 35.3067 |
| 733 | 2 | 82.1747 | 731 | 2 | 4.2674 |

```
       .   .  .    ..                                 .
+---------+---------+---------+---------+---------+-------
             GF SRI Adds with Annual BRF Update
   .   :.        .      .
+---------+---------+---------+---------+---------+-------
0.00     15.00     30.00     45.00     60.00     75.00
             GF SRI Adds w/o Annual BRF Update
```

Figure 21. SSBN-726 GF SRI ISNSL Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 47
SSBN-726 GF SRI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI w/BRF Update VS GF SRI w/o BRF Update

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI w/BRF | 6 | 32.9 | 25.2 | 10 |
| GF SRI w/o BRF | 6 | 16.4 | 11.7 | 4.8 |

95 % CI FOR MU GF SRIw/BRF - MU GF SRI w/o BRF: (-10, 43.3)
TTEST MU GF SRIw/BRF = MU GF SRI w/o BRF (VS NE): T=1.45
P=0.19 DF=7.1

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 809 | 809 | 2.09 |
| ERROR | 10 | 3864 | 386 | |
| TOTAL | 11 | 4673 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL      N   MEAN   STDEV   --+---------+---------+---------+---
GF SRI     6  32.85   25.20             (-----------*----------)
w/BRF
GF SRI     6  16.43   11.73    (----------*----------)
w/o BRF
                              --+---------+---------+---------+---
POOLED STDEV = 19.66            0        16        32        48
```

TABLE 48
SSBN-726 GF OSI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update An ISNSL Factor | | | Annual BRF Update Not an ISNSL Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | GF OSI Adds % | HULL | ISNSL | GF OSI Adds % |
| 727 | 2 | 22.3631 | 726 | 3 | 2.3256 |
| 727 | 5 | 14.9011 | 726 | 4 | 7.9519 |
| 729 | 2 | 13.9737 | 726 | 6 | 17.1318 |
| 730 | 3 | 33.5182 | 729 | 3 | 5.7580 |
| 731 | 3 | 9.4610 | 730 | 2 | 46.5283 |
| 733 | 2 | 68.0586 | 731 | 2 | 5.4368 |

```
     .   :         .         .                                 .
-------+---------+---------+---------+---------+---------
             GF OSI Adds w/ BRF Update a Factor
      . : .        .                      .
-------+---------+---------+---------+---------+---------
     12.00     24.00     36.00     48.00     60.00
             GF OSI Adds w/o BRF Update a Factor
```

Figure 22. SSBN-726 GF OSI ISNSL Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 49
SSBN-726 ISNSL GF OSI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF OSI w/BRF Update VS GF OSI w/o BRF Update

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF OSI w/BRF | 6 | 27.0 | 21.8 | 8.9 |
| GF OSI w/o BRF | 6 | 14.2 | 16.6 | 6.8 |

95 % CI FOR MU GF OSI w/BRF - MU GF OSI w/oBRF:(-12.5, 38.2)
TTEST MU GF OSI w/BRF = MU GF OSI w/o BRF (VS NE): T=1.15 P=0.28 DF=9.3

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 496 | 496 | 1.32 |
| ERROR | 10 | 3755 | 376 | |
| TOTAL | 11 | 4251 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV  --+---------+---------+---------+---
GF OSI    6   27.05   21.79          (-----------*-----------)
w/BRF
GF OSI    6   14.19   16.62  (-----------*-----------)
w/o BRF
                             --+---------+---------+---------+---
POOLED STDEV = 19.38           0        14        28        42
```

TABLE 50
SSBN-726 CF SRI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update An ISNSL Factor | | | Annual BRF Update Not an ISNSL Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | CF SRI Adds % | HULL | ISNSL | CF SRI Adds % |
| 727 | 2 | 15.7841 | 726 | 3 | 7.4290 |
| 727 | 5 | 12.7592 | 726 | 4 | 10.5694 |
| 729 | 2 | 14.1665 | 726 | 6 | 10.6084 |
| 730 | 3 | 24.6705 | 729 | 3 | 19.2664 |
| 731 | 3 | 13.5826 | 730 | 2 | 7.1104 |
| 733 | 2 | 27.9159 | 731 | 2 | 9.7345 |

```
                 . ..   .                      .       .
-----+---------+---------+---------+---------+---------+-
             CF SRI Adds w/BRF Update a Factor
   ..    . ..                    .
-----+---------+---------+---------+---------+---------+-
    8.00     12.00     16.00     20.00     24.00
            CF SRI Adds w/o BRF Update a Factor
```

Figure 23. SSBN-726 CF SRI ISNSL Allowance Additions Dotplot Stratified by an Annual BRF Update

TABLE 51
SSBN-726 CF SRI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF SRIw/ BRF Update VS CF SRI w/o BRF Update

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI w/BRF | 6 | 18.15 | 6.47 | 2.6 |
| CF SRI w/o BRF | 6 | 10.79 | 4.42 | 1.8 |

95 % CI FOR MU CF SRIw/BRF - MU CF SRI w/o BRF:(-0.0, 14.7)
TTEST MU CF SRI w/BRF = MU CF SRI w/o BRF (VS NE): T=2.30
P=0.050 DF=8.8

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 162.5 | 162.5 | 5.29 |
| ERROR | 10 | 307.2 | 30.7 | |
| TOTAL | 11 | 469.7 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL     N  MEAN    STDEV  -------+---------+---------+------
CF SRI    6  18.146  6.470                 (---------*---------)
w/BRF
CF SRI    6  10.786  4.425 (-----------*---------)
wo BRF
                            -------+---------+---------+------
POOLED STDEV =  5.542            10.0      15.0      20.0
```

TABLE 52
SSBN-726 CF OSI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update An ISNSL Factor | | | Annual BRF Update Not an ISNSL Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | CF OSI Adds % | HULL | ISNSL | CF OSI Adds % |
| 727 | 2 | 19.2229 | 726 | 3 | 4.6053 |
| 727 | 5 | 23.2500 | 726 | 4 | 1.5915 |
| 729 | 2 | 25.9084 | 726 | 6 | 23.4000 |
| 730 | 3 | 39.0192 | 729 | 3 | 39.3583 |
| 731 | 3 | 32.2995 | 730 | 2 | 25.4758 |
| 733 | 2 | 16.1355 | 731 | 2 | 25.1348 |

```
                 .    .     .    .          .          .
-------+---------+---------+---------+---------+---------
             CF OSI Adds w/BRF Update a Factor
 .   .                             .  :                  .
-------+---------+---------+---------+---------+---------
     7.00     14.00     21.00     28.00     35.00
               CF OSI w/o BRF Update a Factor
```

Figure 24. SSBN-726 CF OSI ISNSL Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 53
SSBN-726 CF OSI ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF OSI w/BRF Update VS CF OSI w/o BRF Update

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF OSI w/BRF | 6 | 25.97 | 8.49 | 3.5 |
| CF OSI w/o BRF | 6 | 19.9 | 14.3 | 5.8 |

95 % CI FOR MU CF OSIw/BRF - MU CF OSI w/o BRF: (-9.6, 21.7)
TTEST MU CF OSI w/BRF = MU CF OSI w/o BRF(VS NE): T=0.89
P=0.40 DF=8.1

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 110 | 110 | 0.80 |
| ERROR | 10 | 1378 | 138 | |
| TOTAL | 11 | 1488 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                     BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV  --------+---------+---------+--------
CF OSI    6   25.97    8.49         (------------*------------)
w/BRF
CF OSI    6   19.93   14.27  (------------*------------)
w/o BRF
                             --------+---------+---------+--------
POOLED STDEV =   11.74             15.0      22.5      30.0
```

TABLE 54
SSBN-726 ISNSL ALLOWANCE ADDITION PERCENTAGES
BY SUPPLIER AND STORAGE LOCATION
ANNUAL BRF UPDATE A FACTOR

| HULL | ISNSL | GF SRI Adds % | GF OSI Adds % | CF SRI Adds % | CF OSI Adds % |
|---|---|---|---|---|---|
| 727 | 2 | 31.4884 | 22.3631 | 15.7841 | 19.2229 |
| 727 | 5 | 18.5143 | 14.9011 | 12.7592 | 23.2500 |
| 729 | 2 | 22.3916 | 13.9737 | 14.1665 | 25.9084 |
| 730 | 3 | 30.1682 | 33.5182 | 24.6705 | 39.0192 |
| 731 | 3 | 12.3750 | 9.4610 | 13.5826 | 32.2995 |
| 733 | 2 | 82.1747 | 68.0586 | 27.9159 | 16.1355 |

```
    .   .  .    ..                                 .
-------+---------+---------+---------+---------+---------
                 GF SRI Adds w/BRF a Factor
    .  ..    .      .                      .
-------+---------+---------+---------+---------+---------
                 GF OSI Adds w/BRF a Factor
      .
      : .    .  .
-------+---------+---------+---------+---------+---------
                 CF SRI Adds w/BRF a Factor
        . . . .    .   .
-------+---------+---------+---------+---------+---------
     15.00     30.00     45.00     60.00     75.00
                 CF OSI Adds w/BRF a Factor
```

Figure 25. SSBN-726 ISNSL Allowance Additions Dotplot
Annual BRF Update a Factor

TABLE 55
SSBN-726 ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE
ANNUAL BRF UPDATE A FACTOR

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 3 | 658 | 219 | 0.72 |
| ERROR | 20 | 6119 | 306 | |
| TOTAL | 23 | 6777 | | |

```
                                        INDIVIDUAL 95 PCT CI'S FOR MEAN
                                             BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV   ---------+---------+---------+------
GF SRI    6   32.85   25.20               (---------*----------)
GF OSI    6   27.05   21.79          (---------*----------)
CF SRI    6   18.15    6.47   (----------*----------)
CF OSI    6   25.97    8.49         (----------*---------)
                              ---------+---------+---------+------
POOLED STDEV =  17.49                 14        28        42
```

TABLE 56
SSBN-726 ISNSL ALLOWANCE ADDITION PERCENTAGES
BY SUPPLIER AND STORAGE LOCATION
ANNUAL BRF UPDATE NOT A FACTOR

| HULL | ISNSL | GF SRI Adds % | GF OSI Adds % | CF SRI Adds % | CF OSI Adds % |
|---|---|---|---|---|---|
| 727 | 3 | 12.3349 | 2.3256 | 7.4290 | 4.6053 |
| 727 | 4 | 10.3161 | 7.9519 | 10.5694 | 1.5915 |
| 727 | 6 | 26.0231 | 17.1318 | 10.6084 | 23.4000 |
| 729 | 3 | 10.3248 | 5.7580 | 19.2664 | 39.3583 |
| 730 | 2 | 35.3067 | 46.5283 | 7.1104 | 25.4758 |
| 731 | 2 | 4.2674 | 5.4368 | 9.7345 | 25.1348 |

```
    .     : .             .        .
+---------+---------+---------+---------+---------+-------
                 GF SRI Adds w/o BRF Update
  .  .. .        .                              .
+---------+---------+---------+---------+---------+-------
                 GF OSI Adds w/o BRF Update
       :  .:       .
+---------+---------+---------+---------+---------+-------
                 CF SRI Adds w/o BRF Update
  .  .                 . :              .
+---------+---------+---------+---------+---------+-------
0.00     10.00     20.00     30.00     40.00     50.00
                 CF OSI Adds w/o BRF Update
```

Figure 26. SSBN-726 ISNSL Allowance Additions Dotplot
Annual BRF Update Not a Factor

TABLE 57
SSBN-726 ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE
ANNUAL BRF UPDATE NOT A FACTOR

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 3 | 266 | 89 | 0.56 |
| ERROR | 20 | 3186 | 159 | |
| TOTAL | 23 | 3452 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                     BASED ON POOLED STDEV
LEVEL     N   MEAN    STDEV   ----------+---------+---------+----
GF SRI    6   16.43   11.73         (----------*----------)
GF OSI    6   14.19   16.62      (-----------*----------)
CF SRI    6   10.79    4.42   (-----------*----------)
CF OSI    6   19.93   14.27            (-----------*----------)
                              ----------+---------+---------+----
POOLED STDEV =   12.62                10        20        30
```

TABLE 58
SSBN-726 ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE BY SUPPLIER,
STORAGE LOCATION AND AFFECT OF ANNUAL BRF UPDATE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 7 | 2291 | 327 | 1.41 |
| ERROR | 40 | 9305 | 233 | |
| TOTAL | 47 | 11595 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL      N    MEAN     STDEV  -+---------+---------+---------+-
GF SRI     6   32.85     25.20                (---------*---------)
GF OSI     6   27.05     21.79             (---------*---------)
CF SRI     6   18.15      6.47       (---------*---------)
CF OSI     6   25.97      8.49             (---------*---------)
                                -+---------+---------+---------+-
                                 0        14        28        42
                    Annual BRF Update a Factor

                                -+---------+---------+---------+-
GF SRI     6   16.43     11.73      (---------*---------)
GF OSI     6   14.19     16.62     (---------*---------)
CF SRI     6   10.79      4.42  (---------*---------)
CF OSI     6   19.93     14.27        (---------*---------)
                                -+---------+---------+---------+-
                                 0        14        28        42
                  Annual BRF Update Not a Factor

POOLED STDEV = 15.2
```

## APPENDIX D

## SSBN-726 ISNSL ALLOWANCE DELETIONS

TABLE 59
SSBN-726 ISNSL ALLOWANCE DELETIONS

| Hull | ISNSL | GF Allw | GF Del | GF % Del | CF Allw | CF Del | CF % Del |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 6744 | 1554 | 23.047 | 7382 | 1101 | 14.914 |
| 727 | 3 | 5525 | 1745 | 31.583 | 7496 | 713 | 9.511 |
| 727 | 4 | 5643 | 295 | 5.227 | 7577 | 323 | 4.262 |
| 727 | 5 | 5802 | 920 | 15.856 | 7344 | 1631 | 22.208 |
| 727 | 6 | 6465 | 682 | 10.549 | 7617 | 523 | 6.866 |
| 729 | 2 | 7383 | 1197 | 16.212 | 6986 | 997 | 14.271 |
| 729 | 3 | 7384 | 672 | 9.100 | 8160 | 393 | 4.816 |
| 730 | 2 | 6383 | 677 | 10.606 | 7068 | 1345 | 19.029 |
| 730 | 3 | 7585 | 947 | 12.485 | 8145 | 1037 | 12.731 |
| 731 | 2 | 7236 | 355 | 4.906 | 8046 | 680 | 8.451 |
| 731 | 3 | 6952 | 1198 | 17.232 | 8128 | 946 | 11.634 |
| 733 | 2 | 7456 | 239 | 3.205 | 8000 | 6706 | 83.825 |

```
             .
    .:  .:.  :   .     .
+---------+---------+---------+---------+---------+---------+-------
          GF ISNSL Allowance Deletes Percent

   : .: : :  . .                                       .
+---------+---------+---------+---------+---------+---------+-------
0.00     15.00     30.00     45.00     60.00     75.00
          CF ISNSL Allowance Deletes Percent
```

Figure 27. SSBN-726 GF vs GF ISNSL Allowance Deletions Dotplot

TABLE 60
SSBN-726 GF VS CF ISNSL ALLOWANCE DELETIONS
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes VS CF Deletes

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes | 12 | 13.33 | 8.15 | 2.4 |
| CF Deletes | 12 | 17.7 | 21.5 | 6.2 |

95 PCT CI FOR MU GF Deletes - MU CF Deletes: (-18.6, 9.9)
TTEST MU GF Deletes = MU CF Deletes (VS NE): T=-0.66 P=0.52
DF=14.1

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 115 | 115 | 0.43 |
| ERROR | 22 | 5822 | 265 | |
| TOTAL | 23 | 5937 | | |

```
                                      INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
LEVEL           N     MEAN   STDEV  ----+---------+---------+------
GF Deletes     12    13.33    8.15(-----------*-----------)
CF Deletes     12    17.71   21.52      (-----------*-----------)
                                    ----+---------+---------+------
POOLED STDEV =     16.27               7.5      15.0      22.5
```

APPENDIX E

SSBN ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

TABLE 61
SSBN-726 CF AND GF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE A FACTOR

| Hull | ISNSL | GF Allw | GF Del | GF % Del | CF Allw | CF Del | CF % Del |
|---|---|---|---|---|---|---|---|
| 727 | 2 | 6744 | 1554 | 23.042 | 7382 | 1101 | 14.914 |
| 727 | 5 | 5802 | 920 | 15.856 | 7344 | 1631 | 22.208 |
| 729 | 2 | 7383 | 1197 | 16.212 | 6986 | 997 | 14.271 |
| 730 | 3 | 7585 | 947 | 12.485 | 8145 | 1037 | 12.731 |
| 731 | 3 | 6952 | 1198 | 17.232 | 8128 | 946 | 11.638 |
| 733 | 2 | 7467 | 239 | 3.200 | 8000 | 6706 | 83.825 |

```
           .
  .     .  :   .
+---------+---------+---------+---------+---------+---------+-------
                 GF ISNSL Allowance Deletes
        :  :   .                                       .
+---------+---------+---------+---------+---------+---------+-------
0.00      15.00     30.00     45.00     60.00     75.00
                 CF ISNSL Allowance Deletes
```

Figure 28. SSBN-726 GF vs CF ISNSL Allowance Deletions Dotplot Annual BRF Update a Factor

TABLE 62
SSBN-726 GF vs CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes Percentage VS CF Deletes Percentage

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes % | 6 | 14.67 | 6.58 | 2.7 |
| CF Deletes % | 6 | 26.6 | 28.3 | 12 |

95 PCT CI FOR MU GF Deletes % - MU CF Deletes %: (-42.4, 19)
TTEST MU GF Deletes % = MU CF Deletes % (VS NE): T=-1.01
P=0.36 DF=5.5

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 427 | 427 | 1.01 |
| ERROR | 10 | 4215 | 422 | |
| TOTAL | 11 | 4642 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                          BASED ON POOLED STDEV
LEVEL        N    MEAN     STDEV  -+---------+---------+---------+-
GF Del %     6   14.67     6.58(-------------*-------------)
CF Del %     6   26.60    28.28        (------------*------------)
                                  -+---------+---------+---------+-
POOLED STDEV =       20.53         0        14        28        42
```

TABLE 63
SSBN-726 GF and CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE NOT A FACTOR

| Hull | ISNSL | GF Allw | GF Del | GF % Del | CF Allw | CF Del | CF % Del |
|---|---|---|---|---|---|---|---|
| 727 | 3 | 5525 | 1745 | 31.583 | 7496 | 713 | 9.511 |
| 727 | 4 | 5643 | 295 | 5.227 | 7577 | 323 | 4.262 |
| 727 | 6 | 6465 | 682 | 10.549 | 7617 | 523 | 6.866 |
| 729 | 3 | 7384 | 672 | 9.100 | 8160 | 393 | 4.816 |
| 730 | 2 | 6383 | 677 | 10.606 | 7068 | 1345 | 19.029 |
| 731 | 2 | 7236 | 355 | 4.906 | 8046 | 680 | 8.451 |

```
  :         .  :                                           .
-+---------+---------+---------+---------+---------+-----
                  GF ISNSL Allowance Deletes
          ..   .  . .                    .
-+---------+---------+---------+---------+---------+-----
5.00     10.00     15.00     20.00     25.00     30.00
                  CF ISNSL Allowance Deletes
```

Figure 29. SSBN-726 GF vs CF ISNSL Allowance Deletions Annual BRF Update Not a Factor

TABLE 64
SSBN-726 GF VS CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE NOT A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes % VS CF Deletes %

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes % | 6 | 12.00 | 9.92 | 4.1 |
| CF Deletes % | 6 | 8.82 | 5.39 | 2.2 |

95 % CI FOR MU GF Deletes % - MU CF Deletes %: (-7.7, 14.1)
TTEST MU GF Deletes % = MU CF Deletes % (VS NE): T=0.69
P=0.51 DF=7.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 30.2 | 30.2 | 0.47 |
| ERROR | 10 | 637.6 | 63.8 | |
| TOTAL | 11 | 667.8 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL       N     MEAN    STDEV  ------+---------+---------+------
GF Del %    6   11.996    9.921      (-------------*-------------)
CF Del %    6    8.823    5.394  (-------------*------------)
                                 -------+---------+---------+-----
POOLED STDEV =     7.985               5.0      10.0      15.0
```

TABLE 65
SSBN-726 GF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | GF % Deletes | Hull | ISNSL | GF % Deletes |
| 727 | 2 | 23.0427 | 727 | 3 | 31.5837 |
| 727 | 5 | 15.8566 | 727 | 4 | 5.2277 |
| 729 | 2 | 16.2129 | 727 | 6 | 10.5491 |
| 730 | 3 | 12.4852 | 729 | 3 | 9.1008 |
| 731 | 3 | 17.2324 | 730 | 2 | 10.6063 |
| 733 | 2 | 3.2007 | 731 | 2 | 4.9060 |

```
                  .               .    .. .        .
+---------+---------+---------+---------+---------+-------
    GF ISNSL Allowance Deletes w/BRF Updating a Factor

       ..     .  :                                 .
+---------+---------+---------+---------+---------+-------
0.00     6.00     12.00     18.00     24.00     30.00
   GF ISNSL Allowance Deletes w/o BRF Updating a Factor
```

Figure 30. SSBN-726 ISNSL GF ISNSL Allowance Deletions Dotplot Stratified by Annual BRF Update

TABLE 66
SSBN-726 GF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes w/BRF Update VS GF Deletes w/o BRF Update

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes w/BRF | 6 | 14.67 | 6.58 | 2.7 |
| GF Deletes w/o BRF | 6 | 12.00 | 9.92 | 4.1 |

95 PCT CI FOR MU GF Deletes w/BRF - MU GF Deletes w/o BRF: (-8.5, 13.9)
TTEST MU GF Deletes w/BRF = MU GF Deletes w/o BRF (VS NE): T=0.55 P=0.60 DF=8.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 21.5 | 21.5 | 0.30 |
| ERROR | 10 | 708.9 | 70.9 | |
| TOTAL | 11 | 730.4 | | |

```
                                        INDIVIDUAL 95 PCT CI'S FOR MEAN
                                              BASED ON POOLED STDEV
LEVEL     N     MEAN   STDEV   +---------+---------+---------+---
GF Del    6   14.672   6.584       (-------------*--------------)
w/BRF
GF Del    6   11.996   9.921   (-------------*-------------)
w/o BRF
                               +---------+---------+---------+---
POOLED STDEV = 8.420          5.0      10.0      15.0      20.0
```

TABLE 67
SSBN-726 CF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | CF % Deletes | Hull | ISNSL | CF % Deletes |
| 727 | 2 | 14.9147 | 727 | 3 | 9.5117 |
| 727 | 5 | 22.2086 | 727 | 4 | 4.2629 |
| 729 | 2 | 14.2714 | 727 | 6 | 6.8662 |
| 730 | 3 | 12.7317 | 729 | 3 | 4.8162 |
| 731 | 3 | 11.6388 | 730 | 2 | 19.0294 |
| 733 | 2 | 83.8250 | 731 | 2 | 8.4514 |

```
         : :    .                                                .
+---------+---------+---------+---------+---------+-------
          CF Allowance Deletes w/BRF Updating a Factor
     :  .:      .
+---------+---------+---------+---------+---------+-------
0.00     15.00     30.00     45.00     60.00     75.00
          CF Allowance Deletes w/o BRF Updating a Factor
```

Figure 31. SSBN-726 CF ISNSL Allowance Deletions Stratified by Annual BRF Update

TABLE 68
SSBN-726 CF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF Deletes % w/BRF VS CF Deletes % w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF Deletes w/BRF | 6 | 26.6 | 28.3 | 12 |
| CF Deletes w/o BRF | 6 | 8.82 | 5.39 | 2.2 |

95 PCT CI FOR MU CF Deletes w/BRF - MU CF Deletes w/o BRF:
(-12, 48.0)
TTEST MU CF Deletes w/BRF = MU CF Deletes w/o BRF (VS NE):
T=1.51 P=0.19 DF=5.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 948 | 948 | 2.29 |
| ERROR | 10 | 4144 | 414 | |
| TOTAL | 11 | 5092 | | |

```
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV ------+---------+---------+---------
CF Del    6   26.60   28.28              (-----------*----------)
w/BRF
CF Del    6    8.82    5.39(-----------*----------)
w/o BRF
                            ------+---------+---------+---------
POOLED STDEV =    20.36           0        16        32
```

APPENDIX F

# THIRD FLIGHT FFG-7 CORRELATION AND REGRESSION ANALYSIS

TABLE 69
THIRD FLIGHT FFG-7 REGRESSION AND CORRELATION DATA

| | | Independent Variable | | | Dependent Variables | | |
|---|---|---|---|---|---|---|---|
| Hull | ISNSL | Config Range | Config Depth | BRF Update | ISNSL Adds | ISNSL Deletes | Total Churn |
| 40 | 4 | 223 | 1042 | 0 | 2661 | 2600 | 5261 |
| 41 | 3 | 557 | 3126 | 1 | 4710 | 4011 | 8721 |
| 41 | 4 | 49 | 250 | 0 | 2244 | 2074 | 4318 |
| 42 | 3 | 334 | 1950 | 1 | 3303 | 11174 | 14477 |
| 42 | 4 | 158 | 480 | 0 | 5349 | 1696 | 7045 |
| 43 | 2 | 1137 | 6410 | 1 | 7290 | 4751 | 12041 |
| 43 | 3 | 134 | 211 | 0 | 2632 | 2384 | 5016 |
| 43 | 4 | 21 | 251 | 1 | 4015 | 3641 | 7656 |
| 45 | 2 | 1002 | 5815 | 0 | 7925 | 3524 | 11449 |
| 45 | 3 | 223 | 487 | 1 | 3292 | 4040 | 7332 |
| 45 | 4 | 38 | 81 | 0 | 1815 | 1836 | 3651 |
| 46 | 2 | 1231 | 7024 | 1 | 7305 | 4931 | 12236 |
| 46 | 3 | 1005 | 347 | 0 | 2910 | 2542 | 5452 |
| 46 | 4 | 34 | 594 | 1 | 3042 | 3869 | 6911 |
| 47 | 2 | 1117 | 6144 | 1 | 8153 | 4080 | 12233 |
| 47 | 3 | 201 | 132 | 0 | 1306 | 2525 | 3831 |
| 47 | 4 | 7 | 265 | 1 | 3004 | 3227 | 6231 |
| 48 | 2 | 1323 | 10122 | 1 | 7807 | 4634 | 12441 |
| 48 | 3 | 302 | 3747 | 1 | 5002 | 4654 | 9656 |
| 48 | 4 | 77 | 1098 | 0 | 2922 | 2736 | 5658 |
| 49 | 2 | 1651 | 6146 | 1 | 8059 | 4442 | 12501 |
| 49 | 3 | 118 | 226 | 0 | 2666 | 2027 | 4693 |
| 49 | 4 | 2 | 62 | 1 | 3997 | 4034 | 8031 |

TABLE 70
THIRD FLIGHT FFG-7 CORRELATION TABLE

| | Config Range | Config Depth | Adds | Deletes | Total Churn |
|---|---|---|---|---|---|
| Config Depth | 0.937 | | | | |
| Adds | 0.900 | 0.899 | | | |
| Deletes | 0.312 | 0.350 | 0.275 | | |
| Total Churn | 0.786 | 0.808 | 0.832 | 0.762 | |
| BRF Update | 0.394 | 0.440 | 0.466 | 0.617 | 0.670 |

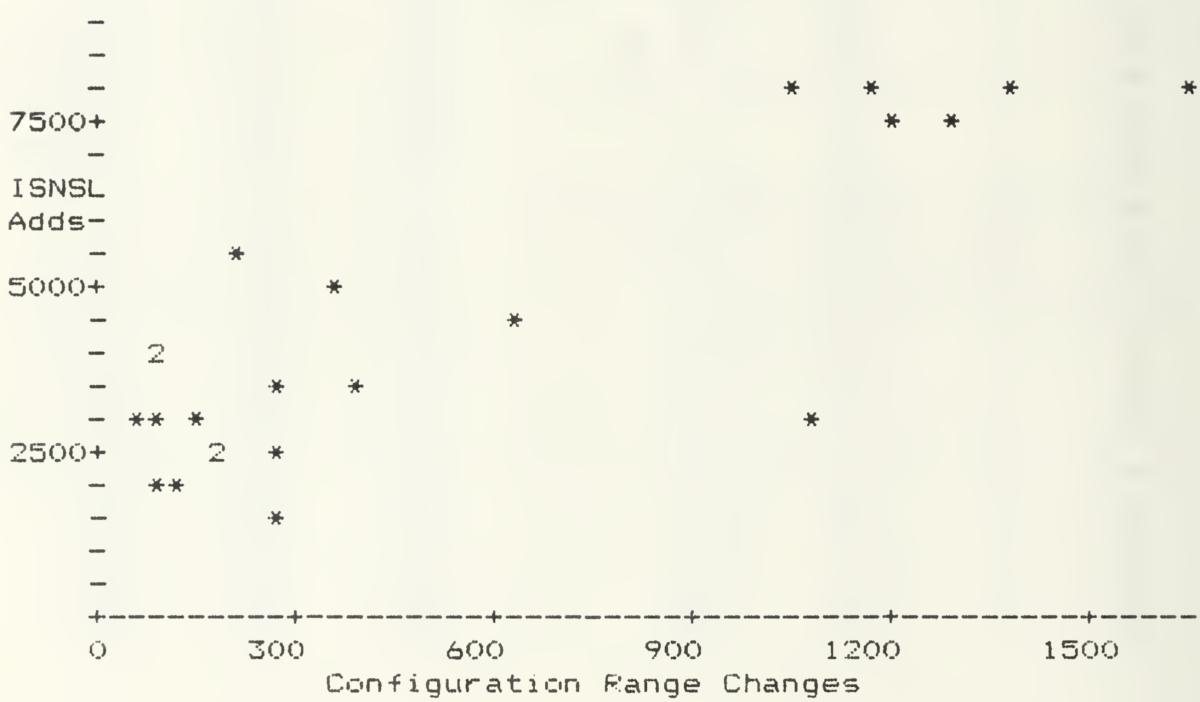


Figure 32. Third Flight FFG-7 ISNSL Date Scatterplot
Configuration Range Changes vs ISNSL Allowance Additions

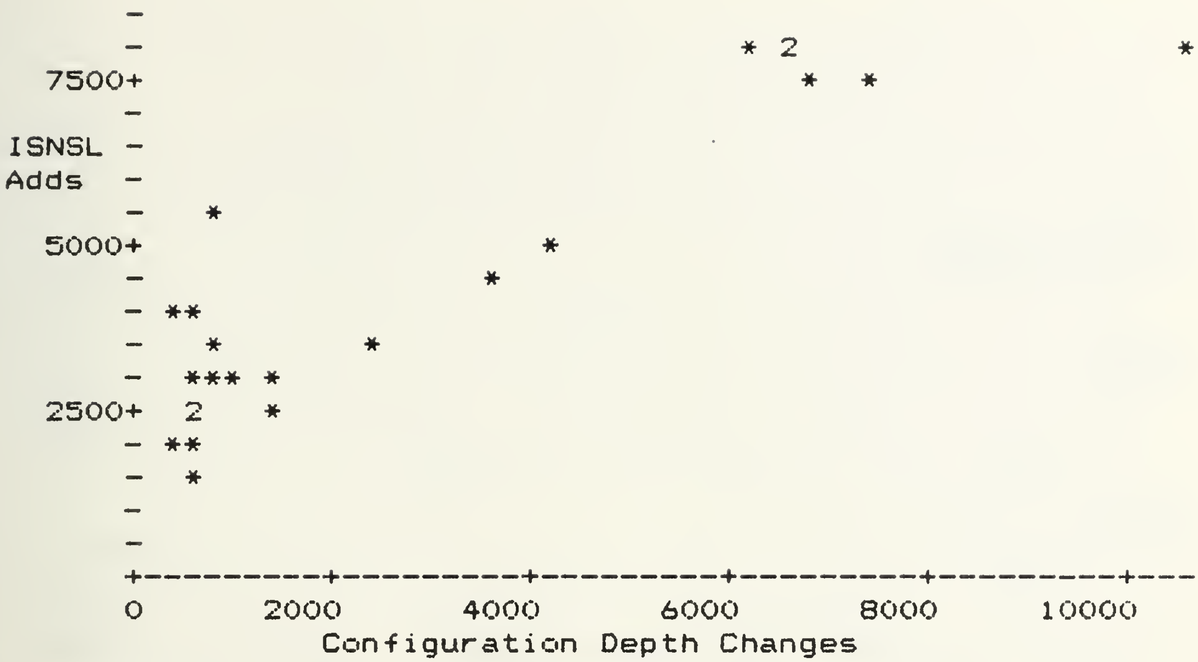


Figure 33. Third Flight FFG-7 ISNSL Data Scatterplot
Configuration Depth Changes vs ISNSL Allowance Additions

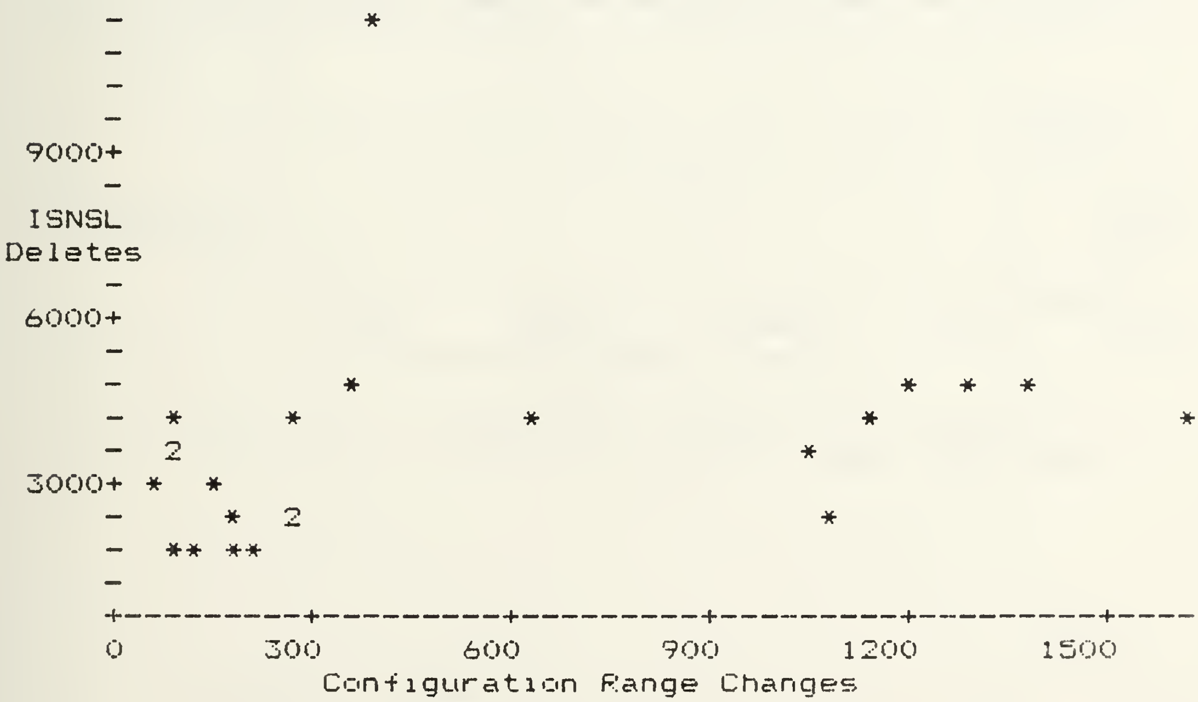


Figure 34. Third Flight FFG-7 ISNSL Data Scatterplot
Configuration Range Changes vs ISNSL Allowance Deletions

```
    -           *
    -
    -
    -
9000+
    -
ISNSL Deletes
    -
    -
6000+
    -
    -                    *            *  *               *
    - * *             *              2
    -  * *                         *
3000+  *   *
    -  2*  *
    - *2*
    -
    +---------+---------+---------+---------+---------+----
    0      2000      4000      6000      8000     10000
               Configuration Depth Changes
```

Figure 35. Third Flight FFG-7 ISNSL Data Scatterplot
Configuration Depth Changes vs ISNSL Allowance Deletions

```
        -            *
   14000+
        -
Total   -                                           *     *
Churn   -                                      **  *
        -                                  *
   10500+
        -           *
        -
        -                    *
        -  2
    7000+  *   * *
        - *
        -    *   *                          *
        -     2
        -   *
    3500+  *     *
        -
        +---------+---------+---------+---------+---------+---------
        0       300       600       900      1200      1500
                Configuration Range Change
```

Figure 36. Third Flight FFG-7 ISNSL Data Scatterplot
Configuration Range Changes vs Total Churn

```
          -            *
     14000+
          -
Total     -                                 *                *
Churn     -                                 **  *
          -                               *
     10500+
          -                     *
          -
          -                  *
          -  **
      7000+    2*
          -   *
          -    *  2
          -   2
          -   *
      3500+  **
          -
          +---------+---------+---------+---------+---------
          0       2000      4000      6000      8000     10000
                   Configuration Depth Changes
```

Figure 37. Third Flight FFG-7 ISNSL Data Scatterplot
Configuration Range Changes vs Total Churn

TABLE 71
THIRD FLIGHT FFG-7 TOTAL CHURN MULTIPLE LINEAR REGRESSION

The regression equation is:

Total Churn = 4952 + 0.708 Config Depth + 2561 BRF Update

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 4952.1 | 539.3 | 9.18 |
| Config Depth | 0.7079 | 0.1315 | 5.38 |
| BRF Update | 2561.3 | 776.0 | 3.30 |

s = 1657 R-sq = 77.5% R-sq(adj) = 75.2%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 2 | 188975904 | 94487952 |
| Error | 20 | 54919824 | 2745991 |
| Total | 22 | 243895728 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| Config Depth | 1 | 159063920 |
| BRF Update | 1 | 29911968 |

TABLE 72
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS
MULTIPLE LINEAR REGRESSION

The regression equation is:
ISNSL Adds = 2459 + 1.09 Config Range + 0.470 Config Depth
+ 502 BRF Update

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 2458.8 | 345.1 | 7.13 |
| Config Range | 1.0949 | 0.8290 | 1.32 |
| Config Depth | 0.4702 | 0.1541 | 3.05 |
| BRF Update | 501.6 | 472.9 | 1.06 |

s = 993.2 R-sq = 83.1% R-sq(adj) = 80.4%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 3 | 91911952 | 30637312 |
| Error | 19 | 18742304 | 986437 |
| Total | 22 | 110654256 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| Config Range | 1 | 77126960 |
| Config Depth | 1 | 13675455 |
| BRF Update | 1 | 1109538 |

TABLE 73
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
MULTIPLE LINEAR REGRESSION

The regression equation is:
ISNSL Deletes = 2331 + 0.302 Config Range + 2214 BRF Update

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 2330.9 | 520.9 | 4.47 |
| Config Range | 0.3019 | 0.7090 | 0.43 |
| BRF Update | 2214.2 | 722.3 | 3.07 |

s = 1578 R-sq = 38.6% R-sq(adj) = 32.4%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 2 | 31280128 | 15640064 |
| Error | 20 | 49809824 | 2490491 |
| Total | 22 | 81089952 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| Config Range | 1 | 7877030 |
| BRF Update | 1 | 23403088 |

## APPENDIX G

## THIRD FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS

TABLE 74
THIRD FLIGHT FFG-7 GF ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | GF SRI Allw | GF SRI Adds | GF SRI Add % | GF OSI Allw | GF OSI Adds | GF OSI Add % |
|---|---|---|---|---|---|---|---|
| 40 | 4 | 9444 | 1140 | 12.071 | 3897 | 168 | 4.311 |
| 41 | 3 | 9903 | 2747 | 27.739 | 3925 | 768 | 19.567 |
| 41 | 4 | 9909 | 1191 | 12.019 | 3967 | 351 | 8.848 |
| 42 | 2 | 5843 | 1697 | 29.043 | 4103 | 790 | 19.254 |
| 42 | 3 | 9848 | 3092 | 31.397 | 4053 | 81 | 1.999 |
| 42 | 4 | 9617 | 886 | 9.213 | 3983 | 119 | 2.988 |
| 43 | 2 | 9823 | 4830 | 49.170 | 4001 | 1012 | 25.294 |
| 43 | 3 | 9475 | 1342 | 14.164 | 3890 | 227 | 5.836 |
| 43 | 4 | 9788 | 2676 | 27.340 | 3923 | 397 | 10.120 |
| 45 | 2 | 10044 | 4803 | 47.820 | 3881 | 1061 | 27.338 |
| 45 | 3 | 9793 | 1899 | 19.391 | 4041 | 417 | 10.319 |
| 45 | 4 | 9814 | 1096 | 11.168 | 3997 | 262 | 6.555 |
| 46 | 2 | 9810 | 4694 | 47.849 | 3809 | 1032 | 27.094 |
| 46 | 3 | 10072 | 1886 | 18.725 | 3992 | 656 | 16.433 |
| 46 | 4 | 9813 | 1770 | 18.037 | 3916 | 214 | 5.465 |
| 47 | 2 | 9827 | 4984 | 50.717 | 4067 | 1077 | 26.481 |
| 47 | 3 | 9474 | 1391 | 14.682 | 3899 | 188 | 4.822 |
| 47 | 4 | 9844 | 1928 | 19.585 | 4045 | 391 | 9.666 |
| 48 | 2 | 9941 | 4842 | 48.707 | 3891 | 1036 | 26.625 |
| 48 | 3 | 9822 | 2474 | 25.188 | 4042 | 713 | 17.640 |
| 48 | 4 | 10120 | 1903 | 18.804 | 3936 | 172 | 4.370 |
| 49 | 2 | 9845 | 4815 | 48.908 | 4043 | 1096 | 27.108 |
| 49 | 3 | 9959 | 1522 | 15.283 | 3976 | 328 | 8.249 |
| 49 | 4 | 9893 | 2814 | 28.444 | 3993 | 257 | 6.436 |

```
                      .                             .
          . .: .:  .:.    . .:. .                  :: .
+---------+---------+---------+---------+---------+-------
               GF SRI Allowance Additions
          .                   :
  ..:::...:     . ...    ..:
+---------+---------+---------+---------+---------+-------
0.00     10.00     20.00     30.00     40.00     50.00
               GF OSI Allowance Additions
```

Figure 38. Third Flight FFG-7 GF SRI vs GF OSI Allowance Additions Dotplot

TABLE 75
THIRD FLIGHT FFG-7 GF SRI VS GF OSI ISNSL ALLOWANCE ADDITIONS T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds VS GF OSI Adds

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI Adds | 24 | 26.9 | 14.3 | 2.9 |
| GF OSI Adds | 24 | 13.45 | 9.16 | 1.9 |

95 PCT CI FOR MU GF SRI Adds - MU GF OSI Adds: (6.4, 20.5)
TTEST MU GF SRI Adds = MU GF OSI Adds (VS NE): T=3.88
P=0.0004 DF=39.2

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 2169 | 2169 | 15.05 |
| ERROR | 46 | 6629 | 144 | |
| TOTAL | 47 | 8798 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                 BASED ON POOLED STDEV
LEVEL          N   MEAN  STDEV --------+---------+---------+--
GF SRI Adds   24  26.89  14.29                 (-------*------)
GF OSI Adds   24  13.45   9.16(-------*-------)
                               --------+---------+---------+--
 POOLED STDEV =    12.00             15.0      22.5      30.0
```

TABLE 76
THIRD FLIGHT FFG-7 CF ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | CF SRI Allw | CF SRI Adds | CF SRI Add % | CF OSI Allw | CF OSI Adds | CF OSI Add % |
|---|---|---|---|---|---|---|---|
| 40 | 4 | 4696 | 1235 | 26.298 | 422 | 118 | 27.962 |
| 41 | 3 | 4018 | 1113 | 27.700 | 380 | 82 | 21.578 |
| 41 | 4 | 4261 | 646 | 15.160 | 415 | 56 | 13.494 |
| 42 | 2 | 2939 | 731 | 24.872 | 351 | 85 | 24.216 |
| 42 | 3 | 4322 | 1349 | 31.212 | 358 | 90 | 25.139 |
| 42 | 4 | 4689 | 737 | 15.717 | 403 | 59 | 14.640 |
| 43 | 2 | 3942 | 1353 | 34.322 | 351 | 95 | 27.065 |
| 43 | 3 | 4488 | 981 | 21.858 | 414 | 82 | 19.806 |
| 43 | 4 | 4562 | 969 | 21.240 | 407 | 22 | 5.405 |
| 45 | 2 | 4440 | 1921 | 43.265 | 359 | 140 | 38.997 |
| 45 | 3 | 4639 | 909 | 19.594 | 398 | 67 | 16.834 |
| 45 | 4 | 4642 | 416 | 8.961 | 404 | 41 | 10.148 |
| 46 | 2 | 3952 | 1471 | 37.221 | 361 | 108 | 29.916 |
| 46 | 3 | 4310 | 940 | 21.809 | 421 | 84 | 19.952 |
| 46 | 4 | 4589 | 1039 | 22.641 | 413 | 19 | 4.600 |
| 47 | 2 | 4296 | 1953 | 45.460 | 342 | 139 | 40.643 |
| 47 | 3 | 4840 | 1019 | 21.053 | 419 | 99 | 23.627 |
| 47 | 4 | 4758 | 652 | 13.703 | 421 | 33 | 7.838 |
| 48 | 2 | 3989 | 1838 | 46.076 | 329 | 91 | 27.659 |
| 48 | 3 | 4617 | 1681 | 36.408 | 425 | 134 | 31.529 |
| 48 | 4 | 4517 | 817 | 18.087 | 424 | 25 | 5.896 |
| 49 | 2 | 4325 | 1997 | 46.173 | 354 | 151 | 42.655 |
| 49 | 3 | 4533 | 720 | 15.883 | 425 | 96 | 22.588 |
| 49 | 4 | 4681 | 887 | 18.948 | 428 | 39 | 9.112 |

```
                                              .
              .        . .:   .: .:.   .  .  .    .    .   ..        .   .:
-------+---------+---------+---------+---------+---------
                    CF SRI Allowance Additions
         .:   .. .    ..  .    : .. :.  .: . .          . . .
-------+---------+---------+---------+---------+---------
     8.00     16.00     24.00     32.00     40.00
                    CF OSI Allowance Additions
```

Figure 39. Third Flight FFG-7 CF SRI vs CF OSI Allowance Additions Dotplot

TABLE 77
THIRD FLIGHT FFG-7 CF SRI VS CF OSI
ISNSL ALLOWANCE ADDITIONS T TEST

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI ADDS | 24 | 26.4 | 11.1 | 2.3 |
| CF OSI ADDS | 24 | 21.3 | 11.1 | 2.3 |

95 PCT CI FOR MU CF SRI ADDS - MU CF OSI ADDS: (-1.3, 11.5)
TTEST MU CF SRI ADDS = MU CF OSI ADDS (VS NE): T=1.59 P=0.12
DF=46.0

TABLE 78
THIRD FLIGHT FFG-7 CF AND GF SRI ISNSL
ALLOWANCE ADDITION PERCENTAGES

| Hull | ISNSL | GF SRI Adds | CF SRI ADDS |
|---|---|---|---|
| 40 | 4 | 12.071 | 26.299 |
| 41 | 3 | 27.739 | 27.700 |
| 41 | 4 | 12.019 | 15.160 |
| 42 | 2 | 29.043 | 24.872 |
| 42 | 3 | 31.397 | 31.212 |
| 42 | 4 | 9.212 | 15.717 |
| 43 | 2 | 49.170 | 34.322 |
| 43 | 3 | 14.163 | 21.858 |
| 43 | 4 | 27.339 | 21.240 |
| 45 | 2 | 47.819 | 43.265 |
| 45 | 3 | 19.391 | 19.594 |
| 45 | 4 | 11.167 | 8.961 |
| 46 | 2 | 47.849 | 37.221 |
| 46 | 3 | 18.725 | 21.809 |
| 46 | 4 | 18.037 | 22.641 |
| 47 | 2 | 50.717 | 45.460 |
| 47 | 3 | 14.682 | 21.053 |
| 47 | 4 | 19.585 | 13.703 |
| 48 | 2 | 48.707 | 46.076 |
| 48 | 3 | 25.188 | 36.408 |
| 48 | 4 | 18.804 | 18.087 |
| 49 | 2 | 48.908 | 46.173 |
| 49 | 3 | 15.282 | 15.883 |
| 49 | 4 | 28.444 | 18.948 |

```
                         .                                                    .
     .  ..:   :.     ::         .   ..:   .                                   ::  .
 -+---------+---------+---------+---------+---------+-----
                     GF SRI Allowance Adds
                                    .
     .       . .:   .: .:.   .  .  .    .    .   ..      .   .:
 -+---------+---------+---------+---------+---------+-----
          8.00     16.00     24.00     32.00     40.00
                      CF SRI Allowance Adds
```

Figure 40. Third Flight FFG-7 GF SRI vs CF SRI Allowance Additions Dotplot

TABLE 79
THIRD FLIGHT FFG-7 GF SRI VS CF SRI ISNSL ALLOWANCE ADDITIONS T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds VS CF SRI Adds

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI Adds | 24 | 26.9 | 14.3 | 2.9 |
| CF SRI Adds | 24 | 26.4 | 11.1 | 2.3 |

95 PCT CI FOR MU GF SRI Adds - MU CF SRI Adds: (-7.0, 7.9)
TTEST MU GF SRI Adds = MU CF SRI Adds (VS NE): T=0.13 P=0.89 DF=43.3

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 3 | 3 | 0.02 |
| ERROR | 46 | 7531 | 164 | |
| TOTAL | 47 | 7534 | | |

```
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV  ---------+---------+---------+------
GF SRI   24   26.89   14.29    (----------------*---------------)
Adds
CF SRI   24   26.40   11.10  (----------------*----------------)
Adds
                             ---------+---------+---------+------
POOLED STDEV =   12.80             24.0      27.0      30.0
```

TABLE 80
THIRD FLIGHT FFG-7 CF AND GF OSI ISNSL
ALLOWANCE ADDITION PERCENTAGES

| Hull | ISNSL | GF OSI Adds | CF OSI Adds |
|---|---|---|---|
| 40 | 4 | 4.311 | 27.962 |
| 41 | 3 | 19.566 | 21.578 |
| 41 | 4 | 8.848 | 13.494 |
| 42 | 2 | 19.254 | 24.216 |
| 42 | 3 | 1.998 | 25.139 |
| 42 | 4 | 2.987 | 14.640 |
| 43 | 2 | 25.293 | 27.065 |
| 43 | 3 | 5.835 | 19.806 |
| 43 | 4 | 10.119 | 5.405 |
| 45 | 2 | 27.338 | 38.997 |
| 45 | 3 | 10.319 | 16.834 |
| 45 | 4 | 6.554 | 10.148 |
| 46 | 2 | 27.093 | 29.916 |
| 46 | 3 | 16.432 | 19.952 |
| 46 | 4 | 5.464 | 4.600 |
| 47 | 2 | 26.481 | 40.643 |
| 47 | 3 | 4.821 | 23.627 |
| 47 | 4 | 9.666 | 7.838 |
| 48 | 2 | 26.625 | 27.659 |
| 48 | 3 | 17.639 | 31.529 |
| 48 | 4 | 4.369 | 5.896 |
| 49 | 2 | 27.108 | 42.655 |
| 49 | 3 | 8.249 | 22.588 |
| 49 | 4 | 6.436 | 9.112 |

```
                                                      .
  .  .:.:: ...:        .. :        .::
+---------+---------+---------+---------+---------+-------
                    GF OSI Allowance Adds
      .:   .. .   ..  .    : .. :.  .: . .         . . .
+---------+---------+---------+---------+---------+-------
                    CF OSI Allowance Adds
0.00      8.00     16.00     24.00     32.00     40.00
```

Figure 41. Third Flight FFG-7 GF OSI vs CF OSI Allowance Additions Dotplot

TABLE 81
THIRD FLIGHT FFG-7 GF OSI vs CF OSI
ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 740 | 740 | 7.16 |
| ERROR | 46 | 4753 | 103 | |
| TOTAL | 47 | 5493 | | |

```
                                        INDIVIDUAL 95 PCT CI'S FOR MEAN
                                               BASED ON POOLED STDEV
LEVEL      N    MEAN   STDEV   --+---------+---------+---------+-
GF OSI    24   13.45    9.16    (-------*-------)
Adds
CF OSI    24   21.30   11.08                  (--------*-------)
Adds
                               --+---------+---------+---------+-
POOLED STDEV =   10.16        10.0      15.0      20.0      25.0
```

TABLE 82
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE
ALL SUPPLIER AND STORAGE LOCATION

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 3 | 2806 | 935 | 7.01 |
| ERROR | 92 | 12284 | 134 | |
| TOTAL | 95 | 15090 | | |

```
                                        INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
LEVEL            N    MEAN   STDEV   -------+---------+---------+--
GF SRI Adds     24   26.89   14.29                    (-----*-----)
GF OSI ADDS     24   13.45    9.16   (-----*-----)
CF SRI ADDS     24   26.40   11.10                   (-----*-----)
CF OSI ADDS     24   21.30   11.08            (-----*------)
                                     -------+---------+---------+--
POOLED STDEV =   11.56                    15.0      22.5      30.0
```

## APPENDIX H

## THIRD FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

TABLE 83
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE ADDITION PERCENTAGES ANNUAL BRF UPDATE A FACTOR

| HULL | ISNSL | GF SRI % Adds | GF OSI % Adds | CF SRI % Adds | CF OSI % Adds |
|---|---|---|---|---|---|
| 41 | 3 | 27.74 | 19.56 | 27.70 | 21.58 |
| 42 | 2 | 29.04 | 19.25 | 24.87 | 24.22 |
| 42 | 4 | 9.21 | 2.99 | 15.72 | 14.64 |
| 43 | 2 | 49.17 | 25.29 | 34.32 | 27.06 |
| 43 | 4 | 27.34 | 10.12 | 21.24 | 5.40 |
| 45 | 3 | 19.39 | 10.32 | 19.59 | 16.83 |
| 46 | 2 | 47.85 | 27.09 | 37.22 | 29.92 |
| 46 | 4 | 18.04 | 5.46 | 22.64 | 4.60 |
| 47 | 2 | 50.72 | 26.48 | 45.46 | 40.64 |
| 47 | 4 | 19.58 | 9.67 | 13.70 | 7.84 |
| 48 | 2 | 48.71 | 26.63 | 46.08 | 27.66 |
| 48 | 3 | 25.19 | 17.64 | 36.41 | 31.53 |
| 49 | 2 | 48.91 | 27.11 | 46.17 | 42.66 |
| 49 | 4 | 28.44 | 6.44 | 18.95 | 9.11 |

TABLE 84
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE ADDITION PERCENTAGES ANNUAL BRF UPDATE NOT A FACTOR

| HULL | ISNSL | GF SRI % Adds | GF OSI % Adds | CF SRI % Adds | CF OSI % Adds |
|---|---|---|---|---|---|
| 40 | 4 | 12.07 | 4.31 | 26.30 | 27.96 |
| 41 | 4 | 12.02 | 8.85 | 15.16 | 13.49 |
| 42 | 3 | 31.40 | 2.00 | 31.21 | 25.14 |
| 43 | 3 | 14.16 | 5.84 | 21.86 | 19.81 |
| 45 | 2 | 47.82 | 27.34 | 43.26 | 29.00 |
| 45 | 4 | 11.17 | 6.55 | 8.96 | 10.15 |
| 46 | 3 | 18.73 | 16.43 | 21.81 | 19.95 |
| 47 | 3 | 14.68 | 4.82 | 21.05 | 23.63 |
| 48 | 4 | 18.80 | 4.37 | 18.09 | 5.90 |
| 49 | 3 | 15.28 | 8.25 | 15.88 | 22.53 |

## TABLE 85
## THIRD FLIGHT FFG-7 GF SRI ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | GF SRI % Adds | Hull | ISNSL | GF SRI % Adds |
| 41 | 3 | 27.74 | 40 | 4 | 12.07 |
| 42 | 2 | 29.04 | 41 | 4 | 12.02 |
| 42 | 4 | 9.21 | 42 | 3 | 31.40 |
| 43 | 2 | 49.17 | 43 | 3 | 14.16 |
| 43 | 4 | 27.34 | 45 | 2 | 47.82 |
| 45 | 3 | 19.39 | 45 | 4 | 11.17 |
| 46 | 2 | 47.85 | 46 | 3 | 18.73 |
| 46 | 4 | 18.04 | 47 | 3 | 14.68 |
| 47 | 2 | 50.72 | 48 | 4 | 18.80 |
| 47 | 4 | 19.58 | 49 | 3 | 15.28 |
| 48 | 2 | 48.71 | | | |
| 48 | 3 | 25.19 | | | |
| 49 | 2 | 48.91 | | | |
| 49 | 4 | 28.44 | | | |

```
                                                                 .
    .          .:       .  ..:                                  .: .
-+---------+---------+---------+---------+---------+-----
      GF SRI Allowance Adds w/BRF Updating a Factor

      .:  :.   :                .                    .
-+---------+---------+---------+---------+---------+-----
8.00     16.00     24.00     32.00     40.00     42.00
     GF SRI Allowance Adds w/o BRF Updating a Factor
```

Figure 42. Third Flight FFG-7 GF SRI Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 86
THIRD FLIGHT FFG-7 CLASS GF SRI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds w/BRF VS GF SRI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI Adds w/BRF | 14 | 32.1 | 14.1 | 3.8 |
| GF SRI Adds w/o BRF | 10 | 19.6 | 11.5 | 3.6 |

95 PCT CI FOR MU GF SRI Adds w/BRF - MU GF SRI Adds w/o BRF:
(1.6, 23.4)
TTEST MU GF SRI Adds w/BRF = MU GF SRI Adds w/o BRF (VS NE):
T=2.38 P=0.027 DF=21.5

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 909 | 909 | 5.27 |
| ERROR | 22 | 3791 | 172 | |
| TOTAL | 23 | 4700 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV  ------+---------+---------+---------
GF SRI   14   32.09   14.13                  (--------*--------)
Adds w/BRF
GF SRI   10   19.61   11.52    (----------*---------)
Adds w/o BRF
                             ------+---------+---------+---------
POOLED STDEV = 13.13             16.0      24.0      32.0
```

TABLE 87
THIRD FLIGHT FFG-7 GF OSI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| HULL | ISNSL | GF OSI % Adds | HULL | ISNSL | GF OSI % Adds |
|---|---|---|---|---|---|
| 41 | 3 | 19.56 | 40 | 4 | 4.31 |
| 42 | 2 | 19.25 | 41 | 4 | 8.85 |
| 42 | 4 | 2.99 | 42 | 3 | 2.00 |
| 43 | 2 | 25.29 | 43 | 3 | 5.84 |
| 43 | 4 | 10.12 | 45 | 2 | 27.34 |
| 45 | 3 | 10.32 | 45 | 4 | 6.55 |
| 46 | 2 | 27.09 | 46 | 3 | 16.43 |
| 46 | 4 | 5.46 | 47 | 3 | 4.82 |
| 47 | 2 | 26.48 | 48 | 4 | 4.37 |
| 47 | 4 | 9.67 | 49 | 3 | 8.25 |
| 48 | 2 | 26.63 | | | |
| 48 | 3 | 17.64 | | | |
| 49 | 2 | 27.11 | | | |
| 49 | 4 | 6.44 | | | |

```
   .    . .     ...              .  ..            . ::
-------+---------+---------+---------+---------+---------
                 GF OSI Adds w/BRF Update
 .     :. ..   ..           .                     .
-------+---------+---------+---------+---------+---------
     5.00     10.00     15.00     20.00     25.00
                GF OSI Adds w/o BRF Update
```

Figure 43. Third Flight FFG-7 GF OSI Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 88
THIRD FLIGHT FFG-7 GF OSI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF OSI Adds w/BRF VS GF OSI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF OSI Adds w/BRF | 14 | 16.72 | 9.00 | 2.4 |
| GF OSI Adds w/o BRF | 10 | 8.88 | 7.59 | 2.4 |

95 PCT CI FOR MU GF OSI Adds w/BRF - MU GF OSI Adds w/o BRF:
(0.8, 14.9)
TTEST MU GF OSI Adds w/BRF = MU GF OSI Adds w/o BRF (VS NE):
T=2.31 P=0.031 DF=21.3

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 358.7 | 358.7 | 5.02 |
| ERROR | 22 | 1570.8 | 71.4 | |
| TOTAL | 23 | 1929.5 | | |

```
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                          BASED ON POOLED STDEV
LEVEL      N    MEAN   STDEV---+---------+---------+---------+--
GF OSI    14   16.71   9.00                (--------*---------)
Adds w/BRF
GF OSI    10    8.87   7.58(----------*----------)
Adds w/o BRF
                           ---+---------+---------+---------+--
POOLED STDEV = 8.450        5.0      10.0      15.0      20.0
```

TABLE 89
THIRD FLIGHT FFG-7 CF SRI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| HULL | ISNSL | CF SRI % Adds | HULL | ISNSL | CF SRI % Adds |
|---|---|---|---|---|---|
| 41 | 3 | 27.70 | 40 | 4 | 26.30 |
| 42 | 2 | 24.87 | 41 | 4 | 15.16 |
| 42 | 4 | 15.72 | 42 | 3 | 31.21 |
| 43 | 2 | 34.32 | 43 | 3 | 21.86 |
| 43 | 4 | 21.24 | 45 | 2 | 43.26 |
| 45 | 3 | 19.59 | 45 | 4 | 8.96 |
| 46 | 2 | 37.22 | 46 | 3 | 21.81 |
| 46 | 4 | 22.64 | 47 | 3 | 21.05 |
| 47 | 2 | 45.46 | 48 | 4 | 18.09 |
| 47 | 4 | 13.70 | 49 | 3 | 15.88 |
| 48 | 2 | 46.08 | | | |
| 48 | 3 | 36.41 | | | |
| 49 | 2 | 46.17 | | | |
| 49 | 4 | 18.95 | | | |

```
                 . .     .. . .    .    .          .  ..          .:
+---------+---------+---------+---------+---------+-------
                    CF SRI Allowance Adds w/BRF
   .         .. .   .:      .      .                .
+---------+---------+---------+---------+---------+-------
7.00     14.00     21.00     28.00     35.00     42.00
                   CF SRI Allowance Adds w/o BRF
```

Figure 44 .Third Flight FFG-7 CF SRI Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 90
THIRD FLIGHT FFG-7 CF SRI ISNSL ALLOWANCE
ADDITIONS STRATIFIED by Annual BRF Update
T TEST AND ANALYSIS OF VARIANCE

T Test for CF SRI Adds w/BRF VS CF SRI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI Adds w/BRF | 14 | 29.3 | 11.5 | 3.1 |
| CF SRI Adds w/o BRF | 10 | 22.36 | 9.57 | 3.0 |

95 PCT CI FOR MU CF SRI Adds w/BRF - MU CF SRI Adds w/o BRF:
(-2.0, 15.9)
TTEST MU CF SRI Adds w/BRF = MU CF SRI Adds w/o BRF (VS NE):
T=1.61 P=0.12 DF=21.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 280 | 280 | 2.42 |
| ERROR | 22 | 2551 | 116 | |
| TOTAL | 23 | 2831 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL    N    MEAN  STDEV  -----+---------+---------+---------
CF SRI  14   29.29  11.52              (---------*---------)
Adds w/BRF
CF SRI  10   22.36   9.57  (-----------*-----------)
Adds w/o BRF
                           -----+---------+---------+---------
POOLED STDEV =   10.77       18.0      24.0      30.0
```

TABLE 91
THIRD FLIGHT FFG-7 CF OSI ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | CF OSI % Adds | HULL | ISNSL | CF OSI % Adds |
| 41 | 3 | 21.58 | 40 | 4 | 27.96 |
| 42 | 2 | 24.22 | 41 | 4 | 13.49 |
| 42 | 4 | 14.64 | 42 | 3 | 25.14 |
| 43 | 2 | 27.06 | 43 | 3 | 19.81 |
| 43 | 4 | 5.40 | 45 | 2 | 29.00 |
| 45 | 3 | 16.83 | 45 | 4 | 10.15 |
| 46 | 2 | 29.92 | 46 | 3 | 19.95 |
| 46 | 4 | 4.60 | 47 | 3 | 23.63 |
| 47 | 2 | 40.64 | 48 | 4 | 5.90 |
| 47 | 4 | 7.84 | 49 | 3 | 22.53 |
| 48 | 2 | 27.66 | | | |
| 48 | 3 | 31.53 | | | |
| 49 | 2 | 42.66 | | | |
| 49 | 4 | 9.11 | | | |

TABLE 92
THIRD FLIGHT FFG-7 CF OSI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF OSI Adds w/BRF VS CF OSI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF OSI Adds w/BRF | 14 | 21.7 | 12.5 | 3.3 |
| CF OSI Adds w/o BRF | 10 | 19.76 | 7.66 | 2.4 |

95 PCT CI FOR MU CF OSI Adds w/BRF - MU CF OSI Adds w/o BRF:
(-6.6, 10.5)
TTEST MU CF OSI Adds w/BRF = MU CF OSI Adds w/o BRF (VS NE):
T=0.47 P=0.64 DF=21.6

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 22 | 22 | 0.19 |
| ERROR | 22 | 2543 | 116 | |
| TOTAL | 23 | 2565 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL       N    MEAN   STDEV   -----+---------+---------+--------
CF OSI     14   21.69   12.45         (-----------*-----------)
Adds w/BRF
CF OSI     10   19.76    7.66   (--------------*-------------)
Adds w/o BRF
                                -----+---------+---------+--------
POOLED STDEV = 10.75                15.0      20.0      25.0
```

TABLE 93
THIRD FLIGHT FFG-7 ANALYSIS OF VARIANCE
STRATIFIED BY ANNUAL BRF UPDATE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 9 | 12990.5 | 1443.4 | 14.51 |
| ERROR | 106 | 10542.9 | 99.5 | |
| TOTAL | 115 | 23533.3 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL     N      MEAN     STDEV  --+---------+---------+----
GF SRI   14    32.095    14.133                     (--*--)
GF OSI   14    16.718     9.000           (--*---)
CF SRI   14    29.291    11.524                   (--*---)
CF OSI   14    21.692    12.450              (---*--)
                                 --+---------+---------+----
                                   0        16        32
                 Annual BRF Update a Factor

                                 --+---------+---------+----
GF SRI   10    19.613    11.521            (---*---)
GF OSI   10     8.876     7.586      (---*--)
CF SRI   10    22.358     9.572              (---*---)
CF OSI   10    19.756     7.660            (---*---)
                                 --+---------+---------+----
                                   0        16        32
               Annual BRF Update Not a Factor
POOLED STDEV =  9.973
```

## APPENDIX I

## THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS

TABLE 94
THIRD FLIGHT FFG-7 ALLOWANCE DELETIONS

| Hull | ISNSL | GF Allw | GF Del | GF % Del | CF Allw | CF Del | CF % Del |
|---|---|---|---|---|---|---|---|
| 40 | 4 | 13341 | 2111 | 15.823 | 5118 | 489 | 9.554 |
| 41 | 3 | 13828 | 2971 | 21.485 | 4398 | 1040 | 23.647 |
| 41 | 4 | 13867 | 1650 | 11.898 | 4676 | 424 | 9.067 |
| 42 | 3 | 12940 | 8321 | 64.304 | 4681 | 1084 | 23.157 |
| 42 | 4 | 13600 | 1347 | 9.904 | 5092 | 349 | 6.853 |
| 43 | 2 | 13824 | 3631 | 26.265 | 4293 | 1120 | 26.089 |
| 43 | 3 | 13365 | 2015 | 15.076 | 4902 | 369 | 7.527 |
| 43 | 4 | 13711 | 2438 | 17.781 | 4969 | 1203 | 24.210 |
| 45 | 2 | 13925 | 3096 | 22.233 | 4799 | 428 | 8.918 |
| 45 | 3 | 13834 | 2929 | 21.172 | 5037 | 1111 | 22.056 |
| 45 | 4 | 13811 | 1277 | 9.246 | 5046 | 559 | 11.078 |
| 46 | 2 | 13619 | 3854 | 28.298 | 4313 | 1077 | 24.971 |
| 46 | 3 | 14064 | 1963 | 13.957 | 4731 | 579 | 12.238 |
| 46 | 4 | 13729 | 2881 | 20.984 | 5279 | 984 | 18.639 |
| 47 | 2 | 13894 | 3164 | 22.772 | 4638 | 916 | 19.749 |
| 47 | 3 | 13373 | 2108 | 15.763 | 5259 | 417 | 7.929 |
| 47 | 4 | 13889 | 2231 | 16.063 | 5179 | 996 | 19.231 |
| 48 | 2 | 13832 | 3771 | 27.262 | 4318 | 863 | 19.986 |
| 48 | 3 | 13864 | 3616 | 26.081 | 5042 | 1038 | 20.587 |
| 48 | 4 | 14056 | 1927 | 13.709 | 4941 | 809 | 16.373 |
| 49 | 2 | 13888 | 3506 | 25.244 | 4679 | 936 | 20.004 |
| 49 | 3 | 13935 | 1710 | 12.272 | 4958 | 517 | 10.427 |
| 49 | 4 | 13828 | 3017 | 21.818 | 5109 | 1017 | 19.906 |

```
                  :        .
              : :..: . .:: .:..                             .
+---------+---------+---------+---------+---------+-------
                   GF ISNSL Allowance Deletes

                       .:
            ::::.    . ::..:..
+---------+---------+---------+---------+---------+-------

0.00      12.00      24.00      36.00      48.00      60.00
                   CF ISNSL Allowance Deletes
```

Figure 45. Third Flight FFG-7 GF vs CF ISNSL Allowance Deletions Dotplot

TABLE 95
THIRD FLIGHT FFG-7 GF VS CF ISNSL ALLOWANCE DELETIONS
T TEST AND ANALYSIS OF VARIANCE

T Test GF Deletes VS CF Deletes

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes | 23 | 20.8 | 11.1 | 2.3 |
| CF Deletes | 23 | 16.62 | 6.46 | 1.3 |

95 PCT CI FOR MU GF Deletes - MU CF Deletes: (-1.2, 9.6)
TTEST MU GF Deletes = MU CF Deletes (VS NE): T=1.58 P=0.12
DF=35.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 205.5 | 205.5 | 2.51 |
| ERROR | 44 | 3608.3 | 82.0 | |
| TOTAL | 45 | 3813.8 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL    N    MEAN   STDEV   ----------+---------+---------+-----
GF      23   20.84   11.06             (-----------*-----------)
Deletes
CF      23   16.62    6.46    (-----------*-----------)
Deletes
                             ----------+---------+---------+-----
POOLED STDEV =   9.06                16.0      19.2      22.4
```

## APPENDIX J

## THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS STRATIFIED BY ANNUAL BRF UPDATE

TABLE 96
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE A FACTOR

| HULL | ISNSL | GF Allw | GF Del | GF Del % | CF Allw | CF Del | CF Del % |
|---|---|---|---|---|---|---|---|
| 41 | 3 | 13828 | 2971 | 21.4854 | 4398 | 1040 | 23.6471 |
| 42 | 3 | 13600 | 1347 | 9.9044 | 4681 | 1084 | 23.1574 |
| 43 | 2 | 13824 | 3631 | 26.2659 | 4923 | 1120 | 22.7504 |
| 43 | 4 | 13711 | 2438 | 17.7813 | 4469 | 1203 | 26.9188 |
| 45 | 3 | 13834 | 2929 | 21.1725 | 5037 | 1111 | 22.0568 |
| 46 | 2 | 13619 | 3854 | 28.2987 | 4313 | 1077 | 24.9710 |
| 46 | 4 | 13729 | 2881 | 20.9848 | 5279 | 984 | 18.6399 |
| 47 | 2 | 13894 | 3164 | 22.7724 | 4639 | 916 | 19.7456 |
| 47 | 4 | 13889 | 2231 | 16.0631 | 5179 | 996 | 19.2315 |
| 48 | 2 | 13832 | 3771 | 27.2629 | 4318 | 863 | 19.9861 |
| 48 | 3 | 13864 | 3616 | 26.0819 | 5042 | 1038 | 20.5871 |
| 49 | 2 | 13888 | 3505 | 25.2376 | 4679 | 936 | 20.0043 |
| 49 | 4 | 13828 | 3017 | 21.8180 | 5109 | 1017 | 19.9060 |

```
  .                  .    .        :..  .       .  :  .  .
---+---------+---------+---------+---------+---------+---
                    GF Allowance Deletes
                            .
                       . ..: .   . .. .  .     .
---+---------+---------+---------+---------+---------+---
 10.50     14.00     17.50     21.00     24.50
                    CF Allowance Deletes
```

Figure 46. Third Flight FFG-7 GF vs CF ISNSL Allowance Deletions Dotplot - Annual BRF Update a Factor

TABLE 97
THIRD FLIGHT FFG-7 GF VS CF ISNSL ALLOWANCE
DELETIONS ANNUAL BRF UPDATE A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes VS CF Deletes

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes | 13 | 21.93 | 5.12 | 1.4 |
| CF Deletes | 13 | 21.66 | 2.49 | 0.69 |

95 PCT CI FOR MU GF Deletes - MU CF Deletes: (-3.1, 3.60)
TTEST MU GF Deletes = MU CF Deletes (VS NE): T=0.17 P=0.87
DF=17.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 0.5 | 0.5 | 0.03 |
| ERROR | 24 | 389.2 | 16.2 | |
| TOTAL | 25 | 389.7 | | |

```
                                INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL N   MEAN   STDEV  --+---------+---------+---------+---
GF    13  21.933  5.120    (-----------------*---------------)
Deletes
CF    13  21.662  2.493  (-----------------*---------------)
Deletes
                        --+---------+---------+---------+---
 POOLED STDEV =  4.027  19.6      21.0      22.4      23.8
```

TABLE 98
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE NOT A FACTOR

| HULL | ISNSL | GF Allw | GF Del | GF Del % | CF Allw | CF Del | CF Del % |
|---|---|---|---|---|---|---|---|
| 40 | 4 | 13341 | 2111 | 15.8234 | 5118 | 489 | 9.5545 |
| 41 | 4 | 13876 | 1650 | 11.8910 | 4676 | 424 | 9.0676 |
| 42 | 4 | 12940 | 8321 | 64.3045 | 5092 | 349 | 6.8539 |
| 43 | 3 | 13365 | 2015 | 15.0767 | 4902 | 369 | 7.5275 |
| 45 | 2 | 13925 | 3096 | 22.2334 | 4799 | 428 | 8.9185 |
| 45 | 4 | 13811 | 1277 | 9.2462 | 5046 | 559 | 11.0781 |
| 46 | 3 | 14064 | 1963 | 13.9576 | 4731 | 579 | 12.2384 |
| 47 | 3 | 13373 | 2108 | 15.7631 | 5259 | 417 | 7.9293 |
| 48 | 3 | 14056 | 1927 | 13.7094 | 4941 | 809 | 16.3732 |
| 49 | 3 | 13935 | 1710 | 12.2713 | 4958 | 517 | 10.4276 |

```
               .
      . :..:      .                                      .
+---------+---------+---------+---------+---------+-------
                  GF Allowance Deletes
    ::::.    .
+---------+---------+---------+---------+---------+-------
0.00     12.00     24.00     36.00     48.00     60.00
                  CF Allowance Deletes
```

Figure 47. Third Flight FFG-7 GF vs CF ISNSL Allowance Deletions Dotplot - Annual BRF Update Not a Factor

TABLE 99
THIRD FLIGHT FFG-7 GF VS CF ISNSL Allowance DELETIONS ANNUAL BRF UPDATE NOT A FACTOR
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes VS CF Deletes

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes | 10 | 19.4 | 16.1 | 5.1 |
| CF Deletes | 10 | 10.00 | 2.78 | 0.88 |

95 PCT CI FOR MU GF Deletes - MU CF Deletes: (-2.3, 21.14)
TTEST MU GF Deletes = MU CF Deletes (VS NE): T=1.82 P=0.10
DF=9.5

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 445 | 445 | 3.32 |
| ERROR | 18 | 2411 | 134 | |
| TOTAL | 19 | 2856 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL    N     MEAN    STDEV   -------+---------+---------+-----
GF       10    19.43   16.13               (---------*---------)
Deletes
CF       10    10.00    2.78   (----------*----------)
Deletes
                               -------+---------+---------+-----
POOLED STDEV = 11.57                 7.5      15.0      22.5
```

TABLE 100
THIRD FLIGHT FFG-7 GF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annul BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | GF Del % | HULL | ISNSL | GF Del % |
| 41 | 3 | 21.4854 | 40 | 4 | 15.8234 |
| 42 | 3 | 9.9044 | 41 | 4 | 11.8910 |
| 43 | 2 | 26.2659 | 42 | 4 | 64.3045 |
| 43 | 4 | 17.7813 | 43 | 3 | 15.0767 |
| 45 | 3 | 21.1725 | 45 | 2 | 22.2334 |
| 46 | 2 | 28.2987 | 45 | 4 | 9.2462 |
| 46 | 4 | 20.9848 | 46 | 3 | 13.9576 |
| 47 | 2 | 22.7724 | 47 | 3 | 15.7631 |
| 47 | 4 | 16.0631 | 48 | 3 | 13.7094 |
| 48 | 2 | 27.2629 | 49 | 3 | 12.2713 |
| 48 | 3 | 26.0819 | | | |
| 49 | 2 | 25.2376 | | | |
| 49 | 4 | 21.8180 | | | |

```
                              .
       .     .  .  .:.  .:..
-------+---------+---------+---------+---------+---------
       GF Allowance Deletions w/BRF Updating a Factor
          .
      . :..:     .                                 .
-------+---------+---------+---------+---------+---------
     12.00     24.00     36.00     48.00     60.00
      GF Allowance Deletions w/o BRF Updating a Factor
```

Figure 48. Third Flight FFG-7 GF ISNSL Allowance Deletions Dotplot Stratified by Annual BRF Update

TABLE 101
THIRD FLIGHT FFG-7 GF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes w/BRF VS GF Deletes w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes w/BRF | 13 | 21.93 | 5.12 | 1.4 |
| GF Deletes w/o BRF | 10 | 19.4 | 16.1 | 5.1 |

95 % CI FOR MU GF Delete w/BRF - MU GF Deletes w/o BRF:
(-9.3, 14.3)
TTEST MU GF Deletes w/BRF = MU GF Deletes w/o BRF (VS NE):
T=0.47 P=0.65 DF=10.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 35 | 35 | 0.28 |
| ERROR | 21 | 2656 | 126 | |
| TOTAL | 22 | 2692 | | |

```
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL      N    MEAN    STDEV   ------+---------+---------+------
GF Del    13   21.93    5.12         (------------*------------)
w/BRF
GF Del    10   19.43   16.13   (--------------*--------------)
w/o BRF
                                ------+---------+---------+------
POOLED STDEV =   11.25               15.0      20.0      25.0
```

TABLE 102
THIRD FLIGHT FFG-7 CF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annul BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| HULL | ISNSL | CF Del % | HULL | ISNSL | CF Del % |
| 41 | 3 | 23.6471 | 40 | 4 | 9.5545 |
| 42 | 3 | 23.1574 | 41 | 4 | 9.0676 |
| 43 | 2 | 22.7504 | 42 | 4 | 6.8539 |
| 43 | 4 | 26.9188 | 43 | 3 | 7.5275 |
| 45 | 3 | 22.0568 | 45 | 2 | 8.9185 |
| 46 | 2 | 24.9710 | 45 | 4 | 11.0781 |
| 46 | 4 | 18.6399 | 46 | 3 | 12.2384 |
| 47 | 2 | 19.7456 | 47 | 3 | 7.9293 |
| 47 | 4 | 19.2315 | 48 | 3 | 16.3732 |
| 48 | 2 | 19.9861 | 49 | 3 | 10.4276 |
| 48 | 3 | 20.5871 | | | |
| 49 | 2 | 20.0043 | | | |
| 49 | 4 | 19.9060 | | | |

```
                                    .
                                 ...:.   . ...  .    .
-----+---------+---------+---------+---------+---------+-
         CF Allowance Deletes w/BRF Update a Factor

  . .. ... . .  .         .
-----+---------+---------+---------+---------+---------+-
    8.00     12.00     16.00     20.00     24.00
        CF Allowance Deletes w/o BRF Update a Factor
```

Figure 49. Third Flight FFG-7 CF ISNSL Allowance Deletions Dotplot Stratified by Annual BRF Update

TABLE 103
THIRD FLIGHT FFG-7 CF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF Deletes w/BRF VS CF Deletes w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF Deletes w/BRF | 13 | 21.66 | 2.49 | 0.69 |
| CF Deletes w/o BRF | 10 | 10.00 | 2.78 | 0.88 |

95 PCT CI FOR MU CF Deletes w/BRF - MU CF Deletes w/o BRF:
(9.31, 14.01)
TTEST MU CF Deletes w/BRF = MU CF Deletes w/o BRF (VS NE):
T=10.43 P=0.0000 DF=18.3

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 769.08 | 769.08 | 112.07 |
| ERROR | 21 | 144.12 | 6.86 | |
| TOTAL | 22 | 913.20 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL          N    MEAN   STDEV  ---+---------+---------+------
CF Deletes    13   21.66   2.49                        (--*--)
w/BRF
CF Deletes    10    9.99   2.77   (--*--)
w/o BRF
                                  ---+---------+---------+------
POOLED STDEV = 620                  10.0      15.0      20.0
```

TABLE 104
THIRD FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
ANALYSIS OF VARIANCE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 3 | 1012.6 | 337.5 | 5.06 |
| ERROR | 42 | 2800.2 | 66.7 | |
| TOTAL | 45 | 3812.8 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV   ---+---------+---------+---------+
GF Del   13   21.93   5.12                      (-------*------)
w/BRF
CF Del   13   21.66   2.49                     (-------*-------)
w/BRF
GF Del   10   19.42  16.13                 (-------*--------)
w/o BRF
CF Del   10    9.99   2.79  (-------*-------)
w/o BRF
                             ---+---------+---------+---------+-
POOLED STDEV = 8.165            6.0      12.0      18.0      24.0
```

# APPENDIX K

## FOURTH FLIGHT FFG-7 CORRELATION AND REGRESSION ANALYSIS

TABLE 105
FOURTH FLIGHT FFG-7 REGRESSION AND CORRELATION DATA

| | | Independent Variables | | | Dependent Variables | | |
|---|---|---|---|---|---|---|---|
| Hull | ISNSL | Config Range | Config Depth | BRF Update | Allw Adds | Allw Deletes | Total Churn |
| 50 | 2 | 359 | 1224 | 1 | 4647 | 3388 | 8035 |
| 50 | 3 | 57 | 1225 | 0 | 4143 | 1833 | 5976 |
| 51 | 2 | 302 | 2324 | 1 | 3493 | 3024 | 6517 |
| 51 | 3 | 137 | 2417 | 0 | 2880 | 2278 | 5158 |
| 52 | 2 | 505 | 3433 | 0 | 3034 | 2273 | 5307 |
| 52 | 3 | 73 | 1066 | 1 | 4856 | 3402 | 8258 |
| 53 | 2 | 371 | 1248 | 1 | 4497 | 3919 | 8416 |
| 54 | 2 | 106 | 1997 | 0 | 2502 | 2694 | 5196 |
| 54 | 3 | 108 | 1376 | 1 | 3117 | 3248 | 6365 |
| 55 | 2 | 121 | 1410 | 0 | 3006 | 2407 | 5413 |
| 55 | 3 | 25 | 272 | 1 | 4699 | 4338 | 9037 |
| 56 | 2 | 44 | 1304 | 0 | 2531 | 1664 | 4195 |
| 56 | 3 | 26 | 236 | 1 | 3701 | 3059 | 6760 |
| 57 | 2 | 212 | 2708 | 1 | 3477 | 2772 | 6249 |
| 57 | 3 | 34 | 106 | 0 | 3042 | 1583 | 4625 |
| 58 | 2 | 24 | 287 | 1 | 2544 | 3019 | 5563 |
| 58 | 3 | 61 | 230 | 0 | 2835 | 1379 | 4214 |

TABLE 106
FOURTH FLIGHT FFG-7 CORRELATION TABLE

| | Config Range | Config Depth | Allw Adds | Allw Deletes | Total Churn |
|---|---|---|---|---|---|
| Config Depth | 0.686 | | | | |
| Allw Adds | 0.195 | -0.175 | | | |
| Allw Deletes | 0.205 | -0.064 | 0.644 | | |
| Total Churn | 0.221 | -0.131 | 0.904 | 0.909 | |
| BRF Update | 0.118 | -0.170 | 0.568 | 0.829 | 0.773 |

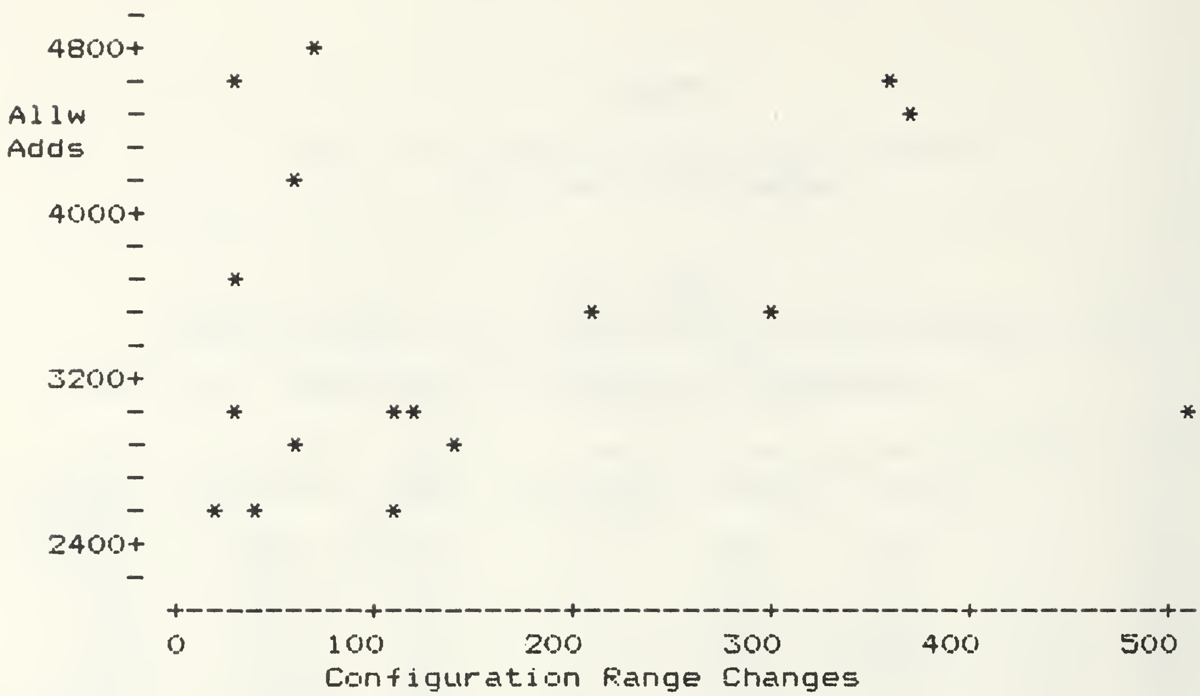


Figure 50. Fourth Flight FFG-7 ISNSL Data Scatterplot
Configuration Range Changes vs ISNSL Allowance Additions

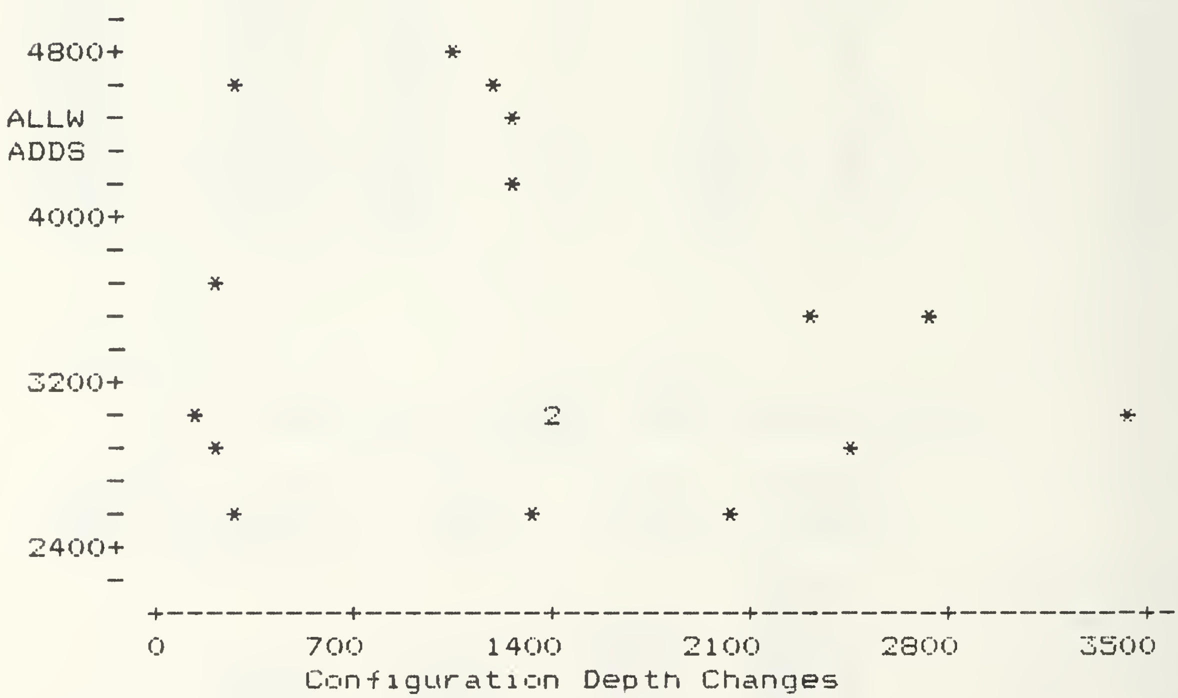


Figure 51. Fourth Flight FFG-7 ISNSL Data Scatterplot
Configuration Depth Changes vs ISNSL Allowance Additions

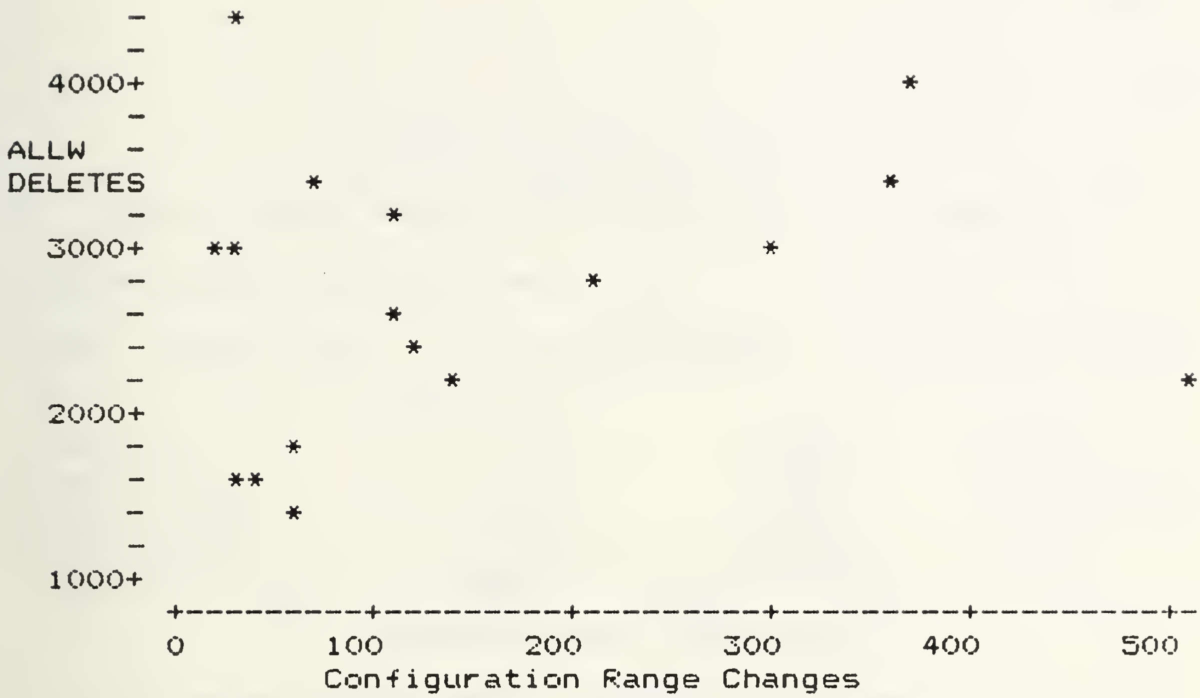


Figure 52. Fourth Flight FFG-7 ISNSL Data Scatterplot
Configuration Range Changes vs ISNSL Allowance Deletions

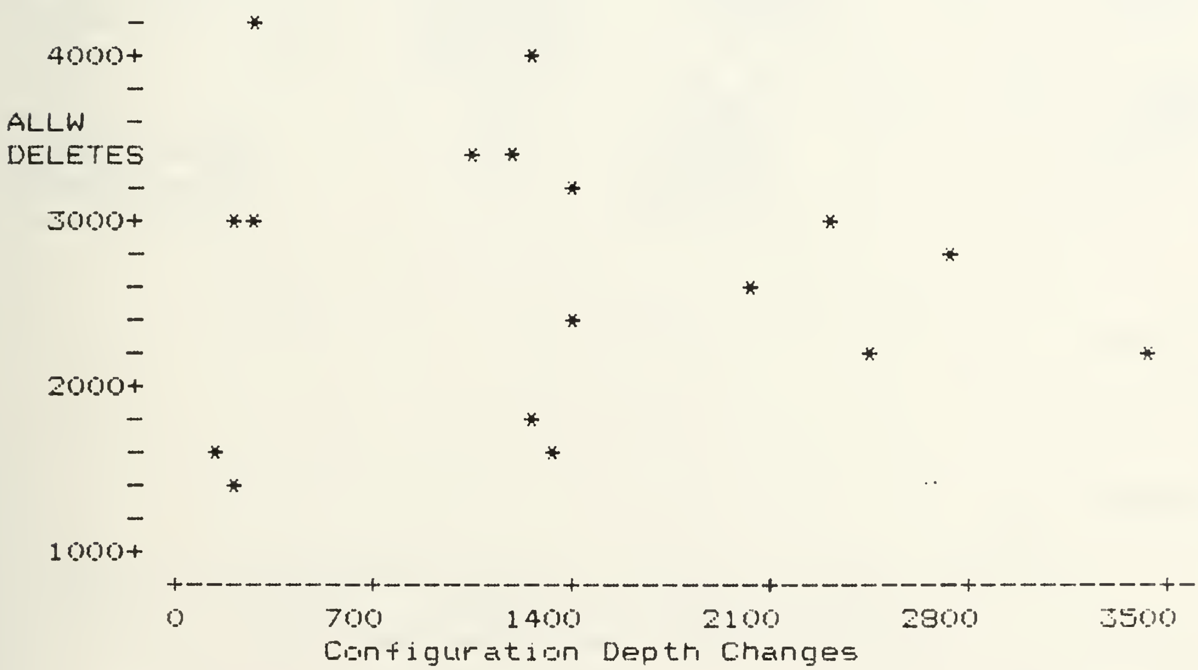


Figure 53. Fourth Flight FFG-7 ISNSL Data Scatterplot
Configuration Depth Changes vs ISNSL Allowance Deletions

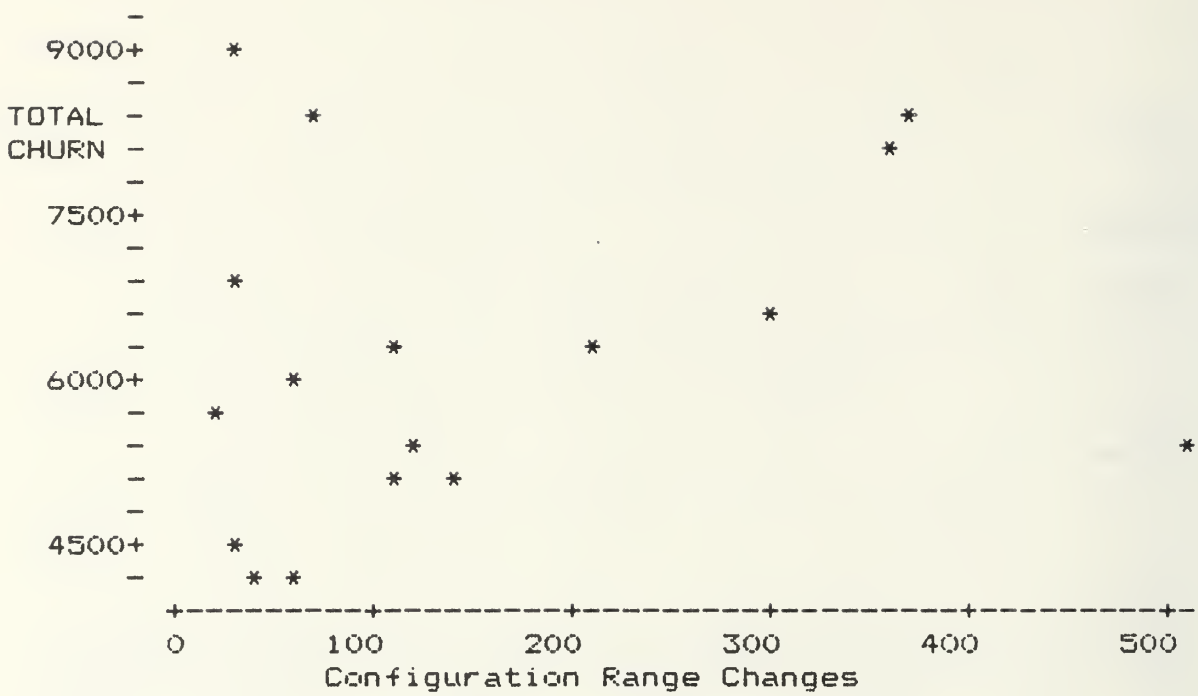


Figure 54. Fourth Flight FFG-7 ISNSL Data Scatterplot
Configuration Range Changes vs ISNSL Total Churn

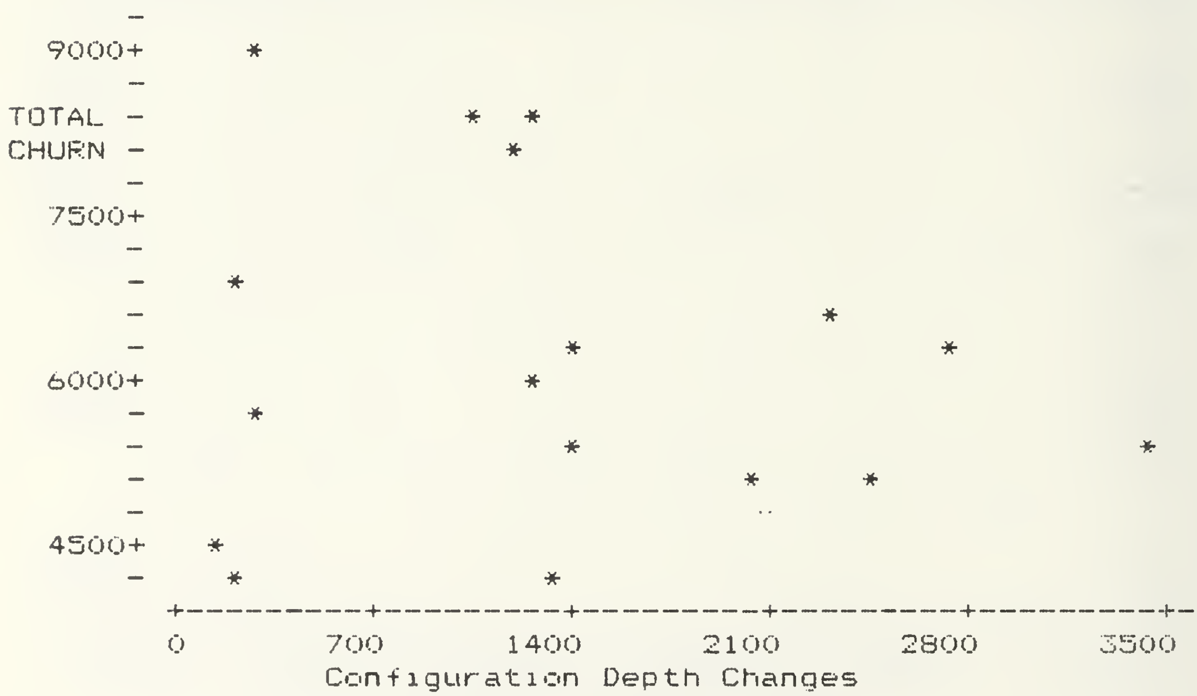


Figure 55. Fourth Flight FFG-7 ISNSL Data Scatterplot
Configuration Depth Changes ISNSL Total Churn

TABLE 107
FOURTH FLIGHT FFG-7 TOTAL CHURN MULTIPLE REGRESSION

The regression equation is:

TOTAL CHURN = 5101 + 2.78(Config Range) − 0.30(Config Depth)
+ 2043(BRF Update)

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 5101.0 | 536.8 | 9.50 |
| CONFIG RANGE | 2.784 | 2.481 | 1.12 |
| CONFIG DEPTH | -0.3043 | 0.3768 | -0.81 |
| BRF UPDATE | 2042.7 | 522.1 | 3.91 |

s = 1001    R-sq = 63.2%    R-sq(adj) = 54.8%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 3 | 22397392 | 7465797 |
| Error | 13 | 13018731 | 1001441 |
| Total | 16 | 35416112 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| CONFIG RANGE | 1 | 1729959 |
| CONFIG DEPTH | 1 | 5341216 |
| BRF UPDATE | 1 | 15326219 |

TABLE 108
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
MULTIPLE LINEAR REGRESSION

The regression equation is:

ALLW DELETES = 1931 + 0.62 CONFIG RANGE + 0.001 CONFIG DEPTH
+ 1308 BRF UPDATE

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 1931.0 | 270.9 | 7.13 |
| CONFIG RANGE | 0.617 | 1.252 | 0.49 |
| CONFIG DEPTH | 0.0005 | 0.1902 | 0.00 |
| BRF UPDATE | 1317.7 | 263.6 | 5.00 |

s = 505.1 R-sq = 69.9% R-sq(adj) = 63.0%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 3 | 7715009 | 2571669 |
| Error | 13 | 3316768 | 255136 |
| Total | 16 | 11031777 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| CONFIG RANGE | 1 | 465434 |
| CONFIG DEPTH | 1 | 871382 |
| BRF UPDATE | 1 | 6378192 |

TABLE 109
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS
MULTIPLE LINEAR REGRESSION

The regression equation is:

ALLW ADDS = 3170 + 2.17 CONFIG RANGE - 0.305 CONFIG DEPTH + 725 BRF UPDATE

| Predictor | Coef | Stdev | t-ratio |
|---|---|---|---|
| Constant | 3170.0 | 373.1 | 8.50 |
| CONFIG RANGE | 2.167 | 1.724 | 1.26 |
| CONFIG DEPTH | -0.3048 | 0.2619 | -1.16 |
| BRF UPDATE | 724.9 | 362.9 | 2.00 |

s = 695.6 R-sq = 40.2% R-sq(adj) = 26.4%

Analysis of Variance

| SOURCE | DF | SS | MS |
|---|---|---|---|
| Regression | 3 | 4228945 | 1409648 |
| Error | 13 | 6290137 | 483857 |
| Total | 16 | 10519082 | |

| SOURCE | DF | SEQ SS |
|---|---|---|
| CONFIG RANGE | 1 | 400755 |
| CONFIG DEPTH | 1 | 1897860 |
| BRF UPDATE | 1 | 1930329 |

## APPENDIX L

## FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS

TABLE 110
FOURTH FLIGHT FFG-7 GF ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | GF SRI Allw | GF SRI Adds | GF SRI Adds % | GF OSI Allw | GF OSI Adds | GF OSI Adds % |
|---|---|---|---|---|---|---|---|
| 50 | 2 | 10277 | 3035 | 29.532 | 4085 | 652 | 15.960 |
| 50 | 3 | 10236 | 3496 | 34.154 | 3938 | 113 | 2.869 |
| 51 | 2 | 10262 | 2093 | 20.395 | 4088 | 246 | 6.017 |
| 51 | 3 | 10463 | 1907 | 18.226 | 3983 | 135 | 3.389 |
| 52 | 2 | 10331 | 1939 | 18.768 | 3939 | 121 | 3.071 |
| 52 | 3 | 10404 | 2986 | 28.700 | 3981 | 628 | 15.774 |
| 53 | 2 | 9704 | 2722 | 28.050 | 4082 | 696 | 17.050 |
| 54 | 2 | 10225 | 1746 | 17.075 | 3942 | 112 | 2.841 |
| 54 | 3 | 10211 | 1596 | 15.630 | 4041 | 350 | 8.661 |
| 55 | 2 | 10281 | 2110 | 20.523 | 3984 | 127 | 3.187 |
| 55 | 3 | 10408 | 3072 | 29.515 | 4056 | 404 | 9.960 |
| 56 | 2 | 10325 | 1639 | 15.874 | 4038 | 243 | 6.017 |
| 56 | 3 | 10492 | 2422 | 23.084 | 4074 | 474 | 11.634 |
| 57 | 2 | 10486 | 1686 | 16.078 | 4084 | 360 | 8.814 |
| 57 | 3 | 10943 | 1784 | 16.302 | 4279 | 573 | 13.391 |
| 58 | 2 | 10396 | 1700 | 16.352 | 4056 | 369 | 9.097 |
| 58 | 3 | 10836 | 1736 | 16.020 | 4299 | 461 | 10.723 |

```
                                :
                               ::. ..  :    .         ..:        .
-------+---------+---------+---------+---------+---------
                               GF SRI Adds
                   :
                   :.    :    .: ...  .   ...
-------+---------+---------+---------+---------+---------
     6.00     12.00     18.00     24.00     30.00
                               GF OSI Adds
```

Figure 56. Fourth Flight FFG-7 GF SRI vs GF OSI Allowance Additions Dotplot

TABLE 111
FOURTH FLIGHT FFG-7 GF SRI vs GF OSI
ISNSL ALLOWANCE ADDITIONS T TEST AND
ANALYSIS OF VARIANCE

T Test for GF SRI ADDS VS GF OSI ADDS

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI ADDS | 17 | 21.43 | 6.15 | 1.5 |
| GF OSI ADDS | 17 | 8.73 | 4.89 | 1.2 |

95 PCT CI FOR MU GF SRI ADDS - MU GF OSI ADDS: (8.8, 16.6)
TTEST MU GF SRI ADDS = MU GF OSI ADDS (VS NE): T=6.66
P=0.0000 DF=30.4

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 1369.9 | 1369.9 | 44.42 |
| ERROR | 32 | 986.9 | 30.8 | |
| TOTAL | 33 | 2356.9 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL      N    MEAN   STDEV--------+---------+---------+-------
GF SRI    17   21.43   6.15                         (-----*----)
ADDS
GF OSI    17    8.73   4.89(----*-----)
ADDS
                           --------+---------+---------+-------
POOLED STDEV = 5.554             10.0      15.0      20.0
```

TABLE 112
FOURTH FLIGHT FFG-7 CF ISNSL ALLOWANCE ADDITIONS

| Hull | ISNSL | CF SRI Allw | CF SRI Adds | CF SRI % Adds | CF OSI Allw | CF OSI Adds | CF OSI % Adds |
|---|---|---|---|---|---|---|---|
| 50 | 2 | 4437 | 932 | 21.005 | 415 | 28 | 6.747 |
| 50 | 3 | 4660 | 498 | 10.686 | 429 | 27 | 6.293 |
| 51 | 2 | 4326 | 1141 | 26.375 | 400 | 13 | 3.250 |
| 51 | 3 | 4299 | 811 | 18.864 | 407 | 27 | 6.633 |
| 52 | 2 | 4417 | 1063 | 24.066 | 409 | 32 | 7.824 |
| 52 | 3 | 4492 | 1204 | 26.803 | 417 | 38 | 9.112 |
| 53 | 2 | 4484 | 1033 | 23.037 | 424 | 46 | 10.849 |
| 54 | 2 | 4319 | 616 | 14.262 | 406 | 28 | 6.896 |
| 54 | 3 | 4275 | 1138 | 26.619 | 427 | 33 | 7.728 |
| 55 | 2 | 4462 | 738 | 16.539 | 428 | 31 | 7.243 |
| 55 | 3 | 4577 | 1168 | 25.518 | 447 | 55 | 12.304 |
| 56 | 2 | 4602 | 619 | 13.450 | 436 | 30 | 6.880 |
| 56 | 3 | 4629 | 783 | 16.915 | 441 | 22 | 4.988 |
| 57 | 2 | 4471 | 1361 | 30.440 | 432 | 70 | 16.203 |
| 57 | 3 | 4646 | 657 | 14.141 | 449 | 28 | 6.236 |
| 58 | 2 | 4552 | 813 | 17.860 | 446 | 31 | 6.950 |
| 58 | 3 | 4788 | 614 | 12.823 | 460 | 24 | 5.217 |

```
                   .    ....  .. . .   .    . .  . :.      .
---+---------+---------+---------+---------+---------+---
                        CF SRI ADDS
      .:
.  :  .::.. .    .  .      .
---+---------+---------+---------+---------+---------+---
  5.00     10.00     15.00     20.00     25.00
                        CF OSI ADDS
```

Figure 57. Fourth Flight FFG-7 CF SRI vs CF OSI Allowance Additions Dotplot

TABLE 113
FOURTH FLIGHT FFG-7 CF SRI VS CF OSI
ISNSL ALLOWANCE ADDITIONS T TEST AND
ANALYSIS OF VARIANCE

T Test for CF SRI ADDS VS CF OSI ADDS

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI ADDS | 17 | 19.97 | 5.98 | 1.5 |
| CF OSI ADDS | 17 | 7.73 | 3.03 | 0.74 |

95 PCT CI FOR MU CF SRI ADDS - MU CF OSI ADDS: (8.9, 15.60)
TTEST MU CF SRI ADDS = MU CF OSI ADDS (VS NE): T=7.52
P=0.0000 DF=23.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 1273.1 | 1273.1 | 56.61 |
| ERROR | 32 | 719.7 | 22.5 | |
| TOTAL | 33 | 1992.8 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                          BASED ON POOLED STDEV
LEVEL      N    MEAN   STDEV  ----------+---------+---------+----
CF SRI    17   19.97   5.98                          (----*----)
ADDS
CF OSI    17    7.73   3.03   (---*----)
ADDS
                              ----------+---------+---------+----
POOLED STDEV =   4.742              10.0      15.0      20.0
```

TABLE 114
FOURTH FLIGHT FFG-7 CF AND GF SRI ISNSL
ALLOWANCE ADDITIONS PERCENTAGES

| Hull | ISNSL | GF SRI % Adds | CF SRI % Adds |
|---|---|---|---|
| 50 | 2 | 29.532 | 21.005 |
| 50 | 3 | 34.154 | 10.686 |
| 51 | 2 | 20.395 | 26.375 |
| 51 | 3 | 18.226 | 18.864 |
| 52 | 2 | 18.768 | 24.066 |
| 52 | 3 | 28.700 | 26.803 |
| 53 | 2 | 28.050 | 23.037 |
| 54 | 2 | 17.075 | 14.262 |
| 54 | 3 | 15.630 | 26.619 |
| 55 | 2 | 20.523 | 16.539 |
| 55 | 3 | 29.515 | 25.518 |
| 56 | 2 | 15.874 | 13.450 |
| 56 | 3 | 23.084 | 16.915 |
| 57 | 2 | 16.078 | 30.440 |
| 57 | 3 | 16.302 | 14.141 |
| 58 | 2 | 16.352 | 17.860 |
| 58 | 3 | 16.020 | 12.823 |

```
                  .
                 .::.  .  .   :      .           .. :        .
---+---------+---------+---------+---------+---------+---
                         GF SRI ADDS
    .     ....    .. . .    .    . .  . :.        .
---+---------+---------+---------+---------+---------+---

  10.00     15.00     20.00     25.00     30.00   35.00
                         CF SRI ADDS
```

Figure 58. Fourth Flight FFG-7 GF SRI vs CF SRI Allowance Additions Dotplot

TABLE 115
FOURTH FLIGHT FFG-7 GF VS CF SRI
ISNSL ALLOWANCE ADDITIONS T TEST AND
ANALYSIS OF VARIANCE

T Test for GF SRI ADDS VS CF SRI ADDS

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI ADDS | 17 | 21.43 | 6.15 | 1.5 |
| CF SRI ADDS | 17 | 19.97 | 5.98 | 1.5 |

95 PCT CI FOR MU GF SRI ADDS - MU CF SRI ADDS: (-2.8, 5.7)
TTEST MU GF SRI ADDS = MU CF SRI ADDS (VS NE): T=0.70 P=0.49
DF=32.0

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 18.2 | 18.2 | 0.49 |
| ERROR | 32 | 1177.7 | 36.8 | |
| TOTAL | 33 | 1195.9 | | |

```
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                         BASED ON POOLED STDEV
LEVEL     N    MEAN   STDEV   ----------+---------+---------+---
GF SRI   17   21.43   6.15         (-----------*-----------)
ADDS
CF SRI   17   19.97   5.98    (-----------*-----------)
ADDS
                              ----------+---------+---------+---
POOLED STDEV =  6.067                 19.2      21.6      24.0
```

TABLE 116
FOURTH FLIGHT FFG-7 CF AND GF OSI ISNSL
ALLOWANCE ADDITION PERCENTAGES

| Hull | ISNSL | GF OSI % Adds | CF OSI % Adds |
|---|---|---|---|
| 50 | 2 | 15.960 | 6.747 |
| 50 | 3 | 2.869 | 6.293 |
| 51 | 2 | 6.017 | 3.250 |
| 51 | 3 | 3.389 | 6.633 |
| 52 | 2 | 3.071 | 7.824 |
| 52 | 3 | 15.774 | 9.112 |
| 53 | 2 | 17.050 | 10.849 |
| 54 | 2 | 2.841 | 6.896 |
| 54 | 3 | 8.661 | 7.728 |
| 55 | 2 | 3.187 | 7.243 |
| 55 | 3 | 9.960 | 12.304 |
| 56 | 2 | 6.017 | 6.880 |
| 56 | 3 | 11.634 | 4.988 |
| 57 | 2 | 8.814 | 16.203 |
| 57 | 3 | 13.391 | 6.236 |
| 58 | 2 | 9.097 | 6.950 |
| 58 | 3 | 10.723 | 5.217 |

```
    .::        :        :.  .  .  .     .       :   .
-----+---------+---------+---------+---------+---------+-
                        GF OSI ADDS
                  .
       .     :   :::. :   .     .    .            .
-----+---------+---------+---------+---------+---------+-
   3.00      6.00      9.00     12.00     15.00     18.00
                        CF OSI ADDS
```

Figure 59. Fourth Flight FFG-7 GF OSI vs CF OSI Allowance Additions Dotplot

TABLE 117
FOURTH FLIGHT FFG-7 GF OSI VS CF OSI
ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE

T Test for GF OSI ADDS VS CF OSI ADDS

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF OSI ADDS | 17 | 8.73 | 4.89 | 1.2 |
| CF OSI ADDS | 17 | 7.73 | 3.03 | 0.74 |

95 PCT CI FOR MU GF OSI ADDS - MU CF OSI ADDS: (-1.9, 3.87)
TTEST MU GF OSI ADDS = MU CF OSI ADDS (VS NE): T=0.72 P=0.48
DF=26.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 8.6 | 8.6 | 0.52 |
| ERROR | 32 | 528.9 | 16.5 | |
| TOTAL | 33 | 537.5 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL      N  MEAN  STDEV   ---------+---------+---------+------
GF OSI    17  8.73  4.89          (-------------*-------------)
ADDS
CF OSI    17  7.73  3.03  (-------------*-------------)
ADDS
                          ---------+---------+---------+------
POOLED STDEV = 4.066              7.0       8.4       9.8
```

TABLE 118
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS
ANALYSIS OF VARIANCE
BY SUPPLIER AND STORAGE LOCATION

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 3 | 2669.0 | 889.7 | 33.36 |
| ERROR | 64 | 1706.6 | 26.7 | |
| TOTAL | 67 | 4375.6 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
LEVEL           N    MEAN   STDEV+---------+---------+---------+-
GF SRI ADDS    17   21.43   6.15                          (---*---)
GF OSI ADDS    17    8.73   4.89  (---*---)
CF SRI ADDS    17   19.97   5.98                       (---*---)
CF OSI ADDS    17    7.73   3.03(---*---)
                                 +---------+---------+---------+-
 POOLED STDEV =     5.164      6.0      12.0      18.0      24.0
```

APPENDIX M

FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS
STRATIFIED BY ANNUAL BRF UPDATE

TABLE 119
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE ADDITIONS
PERCENTAGES ANNUAL BRF UPDATE A FACTOR

| Hull | ISNSL | GF SRI % Adds | GF OSI % Adds | CF SRI % Adds | CF OSI % Adds |
|---|---|---|---|---|---|
| 50 | 2 | 29.53 | 15.96 | 21.00 | 6.75 |
| 51 | 2 | 20.39 | 6.02 | 26.38 | 3.25 |
| 52 | 3 | 28.70 | 5.77 | 26.80 | 9.11 |
| 53 | 2 | 28.05 | 17.05 | 23.04 | 10.85 |
| 54 | 3 | 15.63 | 8.66 | 26.62 | 7.73 |
| 55 | 3 | 29.52 | 9.96 | 25.52 | 12.30 |
| 56 | 3 | 23.08 | 11.63 | 16.92 | 4.99 |
| 57 | 3 | 16.08 | 8.81 | 30.44 | 16.20 |
| 58 | 2 | 16.35 | 9.09 | 17.86 | 6.95 |

TABLE 120
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE ADDITION
PERCENTAGES ANNUAL BRF UPDATE NOT A FACTOR

| Hull | ISNSL % Adds | GF SRI % Adds | GF OSI % Adds | CF SRI % Adds | CF OSI |
|---|---|---|---|---|---|
| 50 | 3 | 34.15 | 2.87 | 10.69 | 6.29 |
| 51 | 3 | 18.23 | 3.39 | 18.86 | 6.63 |
| 52 | 2 | 18.77 | 3.07 | 24.07 | 7.82 |
| 54 | 2 | 17.08 | 2.84 | 14.26 | 6.90 |
| 55 | 2 | 20.52 | 3.19 | 16.54 | 7.24 |
| 56 | 2 | 15.87 | 6.02 | 13.45 | 6.88 |
| 57 | 3 | 16.30 | 13.39 | 14.14 | 6.23 |
| 58 | 3 | 16.02 | 10.72 | 12.82 | 5.22 |

TABLE 121
FOURTH FLIGHT FFG-7 GF SRI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | GF SRI % Adds | Hull | ISNSL | GF SRI % Adds |
| 50 | 2 | 29.53 | 50 | 3 | 34.15 |
| 51 | 2 | 20.39 | 51 | 3 | 18.23 |
| 52 | 3 | 28.70 | 52 | 2 | 18.77 |
| 53 | 2 | 28.05 | 54 | 2 | 17.08 |
| 54 | 3 | 15.63 | 55 | 2 | 20.52 |
| 55 | 3 | 29.52 | 56 | 2 | 15.87 |
| 56 | 3 | 23.08 | 57 | 3 | 16.30 |
| 57 | 3 | 16.08 | 58 | 3 | 16.02 |
| 58 | 2 | 16.35 | | | |

```
  ...          .       .             . . :
-------+---------+---------+---------+---------+---------
                     GF SRI Adds w/BRF
  ... .  . .    .                                      .
-------+---------+---------+---------+---------+---------
     17.50     21.00     24.50     28.00     31.50
                    GF SRI Adds w/o BRF
```

Figure 60. Fourth FFG-7 Class GF SRI Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 122
FOURTH FLIGHT FFG-7 GF SRI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF SRI Adds w/BRF VS GF SRI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF SRI Adds w/BRF | 9 | 23.04 | 6.09 | 2.0 |
| GF SRI Adds w/o BRF | 8 | 19.62 | 6.08 | 2.2 |

95 PCT CI FOR MU GF SRI Adds w/BRF - MU GF SRI Adds w/o BRF: (-2.9, 9.8)
TTEST MU GF SRI Adds w/BRF = MU GF SRI Adds w/o BRF (VS NE): T=1.16 P=0.27 DF=14.8

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 49.5 | 49.5 | 1.34 |
| ERROR | 15 | 555.5 | 37.0 | |
| TOTAL | 16 | 605.0 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL       N      MEAN   STDEV-+---------+---------+---------+-
GF SRI      9     23.04   6.09          (---------*---------)
Adds w/BRF
GF SRI      8     19.62   6.08 (---------*----------)
Adds w/o BRF
                                -+---------+---------+---------+-
POOLED STDEV = 6.085          16.0      20.0      24.0      28.0
```

TABLE 123
FOURTH FLIGHT FFG-7 GF OSI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | GF OSI % Adds | Hull | ISNSL | GF OSI % Adds |
| 50 | 2 | 15.96 | 50 | 3 | 2.87 |
| 51 | 2 | 6.02 | 51 | 3 | 3.39 |
| 52 | 3 | 5.77 | 52 | 2 | 3.07 |
| 53 | 2 | 17.05 | 54 | 2 | 2.84 |
| 54 | 3 | 8.66 | 55 | 2 | 3.19 |
| 55 | 3 | 9.96 | 56 | 2 | 6.02 |
| 56 | 3 | 11.63 | 57 | 3 | 13.39 |
| 57 | 3 | 8.81 | 58 | 3 | 10.72 |
| 58 | 2 | 9.09 | | | |

```
                 ..         :.  .       .               .    .
-----+---------+---------+---------+---------+---------+-
                         GF OSI Adds w/BRF
        .::             .              .         .
-----+---------+---------+---------+---------+---------+-
   3.00      6.00      9.00     12.00     15.00     18.00
                        GF OSI Adds w/o BRF
```

Figure 61. Fourth FFG-7 GF OSI ISNSL Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 124
FOURTH FLIGHT FFG-7 GF OSI ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF OSI Adds w/BRF VS GF OSI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF OSI Adds w/BRF | 9 | 10.33 | 3.95 | 1.3 |
| GF OSI Adds w/o BRF | 8 | 5.69 | 4.13 | 1.5 |

95 % CI FOR MU GF OSI Adds w/BRF - MU GF OSI Adds w/o BRF:
(0.4, 8.9)
TTEST MU GF OSI Adds w/BRF = MU GF OSI Adds w/o BRF (VS NE):
T=2.36 P=0.033 DF=14.6

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 91.2 | 91.2 | 5.61 |
| ERROR | 15 | 243.9 | 16.3 | |
| TOTAL | 16 | 335.1 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                 BASED ON POOLED STDEV
LEVEL       N   MEAN   STDEV  +---------+---------+---------+---
GF OSI      9  10.33   3.95                (---------*---------)
Adds w/BRF
GF OSI      8   5.69   4.13  (---------*---------)
Adds w/o BRF
                              +---------+---------+---------+---
POOLED STDEV = 4.032         3.0       6.0       9.0      12.0
```

TABLE 125
FOURTH FLIGHT FFG-7 CF SRI ISNSL ALLOWANCE
ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | CF SRI % Adds | Hull | ISNSL | CF SRI % Adds |
| 50 | 2 | 21.00 | 50 | 3 | 10.69 |
| 51 | 2 | 26.38 | 51 | 3 | 18.86 |
| 52 | 3 | 26.80 | 52 | 2 | 24.07 |
| 53 | 2 | 23.04 | 54 | 2 | 14.26 |
| 54 | 3 | 26.62 | 55 | 2 | 16.54 |
| 55 | 3 | 25.52 | 56 | 2 | 13.45 |
| 56 | 3 | 16.92 | 57 | 3 | 14.14 |
| 57 | 3 | 30.44 | 58 | 3 | 12.82 |
| 58 | 2 | 17.86 | | | |

```
                     .  .      .     .     . .:        .
-----+---------+---------+---------+---------+---------+-
                   CF SRI Adds w/BRF
  .    . ...    .     .           .
-----+---------+---------+---------+---------+---------+-
   12.00     16.00     20.00     24.00     28.00     32.00
                   CF SRI Adds w/o BRF
```

Figure 62. Fourth FFG-7 CF SRI ISNSL Allowance Additions Dotplot Stratified by Annual BRF Update

## TABLE 126
## FOURTH FLIGHT FFG-7 CF SRI ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE T TEST AND ANALYSIS OF VARIANCE

T Test for CF SRI Adds w/BRF VS CF SRI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF SRI Adds w/BRF | 9 | 23.84 | 4.50 | 1.5 |
| CF SRI Adds w/o BRF | 8 | 15.60 | 4.20 | 1.5 |

95 PCT CI FOR MU CF SRI Adds w/BRF - MU CF SRI Adds w/o BRF:
(3.7, 12.8)
TTEST MU CF SRI Adds w/BRF = MU CF SRI Adds w/o BRF (VS NE):
T=3.90 P=0.0016 DF=14.9

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 287.5 | 287.5 | 15.11 |
| ERROR | 15 | 285.3 | 19.0 | |
| TOTAL | 16 | 572.8 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL      N    MEAN   STDEV  --------+---------+---------+------
CF SRI     9   23.84   4.49                    (-------*------)
Adds w/BRF
CF SRI     8   15.60   4.20  (-------*-------)
Adds w/o BRF
                              -------+---------+---------+------
POOLED STDEV = 4.361               16.0      20.0      24.0
```

## TABLE 127
## FOURTH FLIGHT FFG-7 CF OSI ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | CF OSI % Adds | Hull | ISNSL | CF OSI % Adds |
| 50 | 2 | 6.75 | 50 | 3 | 6.29 |
| 51 | 2 | 3.25 | 51 | 3 | 6.63 |
| 52 | 3 | 9.11 | 52 | 2 | 7.82 |
| 53 | 2 | 10.85 | 54 | 2 | 6.90 |
| 54 | 3 | 7.73 | 55 | 2 | 7.24 |
| 55 | 3 | 12.30 | 56 | 2 | 6.88 |
| 56 | 3 | 4.99 | 57 | 3 | 6.23 |
| 57 | 3 | 16.20 | 58 | 3 | 5.22 |
| 58 | 2 | 6.95 | | | |

```
    .      .      ..  .    .       .     .           .
+---------+---------+---------+---------+---------+-------
                    CF OSI Adds w/o BRF
           .   :  .:.  .
+---------+---------+---------+---------+---------+-------
2.50      5.00      7.50     10.00     12.50     15.00
                    CF OSI Adds w/o BRF
```

Figure 63. Fourth FFG-7 CF OSI ISNSL Allowance Additions Dotplot Stratified by Annual BRF Update

TABLE 128
FOURTH FLIGHT FFG-7 CF OSI ISNSL ALLOWANCE ADDITIONS STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF OSI Adds w/o BRF VS CF OSI Adds w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF OSI Adds w/o BRF | 9 | 8.68 | 3.96 | 1.3 |
| CF OSI Adds w/o BRF | 8 | 6.651 | 0.773 | 0.27 |

95 % CI FOR MU CF OSI Adds w/o BRF - MU CF OSI Adds w/o BRF: (-1.1, 5.14)
TTEST MU CF OSI Adds w/o BRF = MU CF OSI Adds w/o BRF (VS NE): T=1.51 P=0.17 DF=8.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 17.45 | 17.45 | 2.02 |
| ERROR | 15 | 129.45 | 8.63 | |
| TOTAL | 16 | 146.90 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL         N   MEAN   STDEV  -------+---------+---------+----
CF OSI        9   8.68   3.96            (---------*----------)
Adds w/o BRF
CF OSI        8   6.65   0.77   (----------*----------)
Adds w/o BRF
                                -------+---------+---------+-----
POOLED STDEV =  2.938                 6.0       8.0      10.0
```

TABLE 129
FOURTH FLIGHT FFG-7 ANALYSIS OF VARIANCE
STRATIFIED BY ANNUAL BRF UPDATE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 7 | 3234.0 | 462.0 | 22.83 |
| ERROR | 60 | 1214.1 | 20.2 | |
| TOTAL | 67 | 4448.1 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                          BASED ON POOLED STDEV
LEVEL          N    MEAN   STDEV      --+---------+---------+------
GF SRI Adds    9   23.04    6.09                          (---*---)
GF OSI Adds    9   10.33    3.95          (---*---)
CF SRI Adds    9   23.84    4.49                          (---*---)
CF OSI Adds    9    8.68    3.96        (---*---)
                                      --+---------+---------+------
                                       7.5      15.0      22.5
Annual BRF Update a Factor


GF SRI Adds    8   19.62    6.08                    (---*---)
GF OSI Adds    8    5.69    4.13(---*---)
CF SRI Adds    8   15.60    4.20               (---*---)
CF OSI Adds    8    6.65    0.77(---*---)
                                      --+---------+---------+------
                                       7.5      15.0      22.5
Annual BRF Update Not a Factor
POOLED STDEV = 4.49
```

## APPENDIX N

## FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS

TABLE 130
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS

| Hull | ISNSL | GF Allw | GF Del | GF % Del | CF Allw | CF Del | CF % Del |
|---|---|---|---|---|---|---|---|
| 50 | 2 | 14362 | 2327 | 16.202 | 4852 | 1061 | 21.867 |
| 50 | 3 | 14174 | 1560 | 11.006 | 5089 | 273 | 5.364 |
| 51 | 2 | 14350 | 2304 | 16.055 | 4726 | 720 | 15.234 |
| 51 | 3 | 14446 | 1594 | 11.034 | 4706 | 684 | 14.534 |
| 52 | 2 | 14270 | 2022 | 14.169 | 4826 | 251 | 5.201 |
| 52 | 3 | 14385 | 2298 | 15.975 | 4909 | 1104 | 22.489 |
| 53 | 2 | 13789 | 2740 | 19.870 | 4908 | 1179 | 24.022 |
| 54 | 2 | 14167 | 2175 | 15.352 | 4725 | 519 | 10.984 |
| 54 | 3 | 14252 | 2111 | 14.812 | 4702 | 1137 | 24.181 |
| 55 | 2 | 14265 | 2050 | 14.370 | 4890 | 357 | 7.300 |
| 55 | 3 | 14464 | 3335 | 23.057 | 5024 | 1003 | 19.964 |
| 56 | 2 | 14363 | 1205 | 8.389 | 5038 | 459 | 9.110 |
| 56 | 3 | 14566 | 2182 | 14.980 | 5070 | 877 | 17.297 |
| 57 | 2 | 14570 | 2144 | 14.715 | 4903 | 628 | 12.808 |
| 57 | 3 | 15222 | 1211 | 7.955 | 5095 | 372 | 7.301 |
| 58 | 2 | 14425 | 2014 | 13.961 | 4998 | 1005 | 20.108 |
| 58 | 3 | 15135 | 1119 | 7.393 | 5248 | 260 | 4.954 |

```
                               .
      . ..      ..       :.:.. :          .        .
-----+---------+---------+---------+---------+---------+-
                         GF Deletes
.
:     :    .    .     .    . .    .       :    . .    :
-----+---------+---------+---------+---------+---------+-
    7.00     10.50     14.00     17.50     21.00     24.50
                         CF Deletes
```

Figure 64. Fourth Flight FFG-7 GF vs CF ISNSL Allowance Deletions Dotplot

TABLE 131
FOURTH FLIGHT FFG-7 GF VS CF ISNSL ALLOWANCE DELETIONS
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes VS CF Deletes

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes | 17 | 14.08 | 4.05 | 0.98 |
| CF Deletes | 17 | 14.28 | 6.98 | 1.7 |

95 PCT CI FOR MU GF Deletes - MU CF Deletes: (-4.24, 3.8)
TTEST MU GF Deletes = MU CF Deletes (VS NE): T=-0.10 P=0.92
DF=25.7

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 0.3 | 0.3 | 0.01 |
| ERROR | 32 | 1043.2 | 32.6 | |
| TOTAL | 33 | 1043.6 | | |

```
                                          INDIVIDUAL 95 PCT CI'S FOR MEAN
                                               BASED ON POOLED STDEV
LEVEL    N    MEAN   STDEV  ---------+---------+---------+------
GF      17   14.08   4.05   (----------------*----------------)
Deletes
CF      17   14.23   6.98    (----------------*----------------)
Deletes
                            ---------+---------+---------+------
POOLED STDEV =  5.710             12.8      14.4      16.0
```

# APPENDIX O

## FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS STRATIFIED BY ANNUAL BRF UPDATE

TABLE 132
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | | Annual BRF Update Not a Factor | | | |
|---|---|---|---|---|---|---|---|
| Hull | ISNSL | GF % Del | CF % Del | Hull | ISNSL | GF % Del | CF % Del |
| 50 | 2 | 16.202 | 21.867 | 50 | 3 | 11.006 | 5.364 |
| 51 | 2 | 16.055 | 15.234 | 51 | 3 | 11.034 | 14.534 |
| 52 | 3 | 15.975 | 22.489 | 52 | 2 | 14.169 | 5.201 |
| 53 | 2 | 19.870 | 24.022 | 54 | 2 | 15.352 | 10.984 |
| 54 | 3 | 14.812 | 24.181 | 55 | 2 | 14.370 | 7.300 |
| 55 | 3 | 23.057 | 19.964 | 56 | 2 | 8.389 | 9.110 |
| 56 | 3 | 14.980 | 17.297 | 57 | 3 | 7.955 | 7.301 |
| 57 | 2 | 14.715 | 12.808 | 58 | 3 | 7.393 | 4.954 |
| 58 | 2 | 13.961 | 20.801 | | | | |

TABLE 133
FOURTH FLIGHT FFG-7 GF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | GF % Deletes | Hull | ISNSL | GF % Deletes |
| 50 | 2 | 16.202 | 50 | 3 | 11.006 |
| 51 | 2 | 16.055 | 51 | 3 | 11.034 |
| 52 | 3 | 15.975 | 52 | 2 | 14.169 |
| 53 | 2 | 19.870 | 54 | 2 | 15.352 |
| 54 | 3 | 14.812 | 55 | 2 | 14.370 |
| 55 | 3 | 23.057 | 56 | 2 | 8.389 |
| 56 | 3 | 14.980 | 57 | 3 | 7.955 |
| 57 | 2 | 14.715 | 58 | 3 | 7.393 |
| 58 | 2 | 13.961 | | | |

```
                     . :.  .:              .         .
-------+---------+---------+---------+---------+---------
                      GF Deletes w/BRF
  . ..         :         ..  .
-------+---------+---------+---------+---------+---------

     9.00     12.00     15.00     18.00     21.00
                     GF Deletes w/o BRF
```

Figure 65. Fourth Flight FFG-7 GF ISNSL Allowance Deletions Dotplot Stratified by Annual BRF Update

TABLE 134
FOURTH FLIGHT FFG-7 GF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for GF Deletes w/BRF VS GF Deletes w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| GF Deletes w/BRF | 9 | 16.63 | 2.95 | 0.98 |
| GF Deletes w/o BRF | 8 | 11.21 | 3.14 | 1.1 |

95 PCT CI FOR MU GF Deletes w/BRF - MU GF Deletes w/o BRF:
(2.23, 8.6)
TTEST MU GF Deletes w/BRF = MU GF Deletes w/o BRF (VS NE):
T=3.65 P=0.0026 DF=14.5

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 124.26 | 124.26 | 13.44 |
| ERROR | 15 | 138.66 | 9.24 | |
| TOTAL | 16 | 262.92 | | |

```
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                     BASED ON POOLED STDEV
LEVEL          N    MEAN   STDEV-+---------+---------+---------+-
GF Deletes     9   16.63   2.95                (------*-------)
w/BRF
GF Deletes     8   11.21   3.14   (------*-------)
w/o BRF
                                 -+---------+---------+---------+-
POOLED STDEV = 3.040              9.0      12.0      15.0      18.0
```

TABLE 135
FOURTH FLIGHT FFG-7 CF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE

| Annual BRF Update A Factor | | | Annual BRF Update Not a Factor | | |
|---|---|---|---|---|---|
| Hull | ISNSL | CF % Deletes | Hull | ISNSL | CF % Deletes |
| 50 | 2 | 21.867 | 50 | 3 | 5.364 |
| 51 | 2 | 15.234 | 51 | 3 | 14.534 |
| 52 | 3 | 22.489 | 52 | 2 | 5.201 |
| 53 | 2 | 24.022 | 54 | 2 | 10.984 |
| 54 | 3 | 24.181 | 55 | 2 | 7.300 |
| 55 | 3 | 19.964 | 56 | 2 | 9.110 |
| 56 | 3 | 17.297 | 57 | 3 | 7.301 |
| 57 | 2 | 12.808 | 58 | 3 | 4.954 |
| 58 | 2 | 20.801 | | | |

```
                      .      .    .       . .  . .    :
-----+---------+---------+---------+---------+---------+-
                    CF Deletes w/BRF
.
:     :    .    .          .
-----+---------+---------+---------+---------+---------+-
    7.00     10.50     14.00     17.50     21.00     24.50
                   CF Deletes w/o BRF
```

Figure 66. Fourth Flight FFG-7 CF ISNSL Allowance Deletions Dotplot - Annual BRF Update a Factor

TABLE 136
FOURTH FLIGHT FFG-7 CF ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
T TEST AND ANALYSIS OF VARIANCE

T Test for CF Deletes w/BRF VS CF Deletes w/o BRF

| | N | MEAN | STDEV | SE MEAN |
|---|---|---|---|---|
| CF Deletes w/BRF | 9 | 19.85 | 3.96 | 1.3 |
| CF Deletes w/o BRF | 8 | 8.09 | 3.33 | 1.2 |

95 PCT CI FOR MU CF Deletes w/BRF - MU CF Deletes w/o BRF:
(8.0, 15.6)
TTEST MU CF Deletes w/BRF = MU CF Deletes w/o BRF (VS NE):
T=6.64 P=0.0000 DF=15.0

Analysis of Variance

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 1 | 585.5 | 585.5 | 43.20 |
| ERROR | 15 | 203.3 | 13.6 | |
| TOTAL | 16 | 788.8 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                        BASED ON POOLED STDEV
LEVEL          N    MEAN  STDEV  --------+---------+---------+----
CF Deletes     9   19.85   3.96                      (------*-----)
w/BRF
CF Deletes     8    8.09   3.33  (----*-----)
w/o BRF
                                 --------+---------+---------+----
POOLED STDEV = 3.682                    10.0      15.0      20.0
```

TABLE 137
FOURTH FLIGHT FFG-7 ISNSL ALLOWANCE DELETIONS
STRATIFIED BY ANNUAL BRF UPDATE
ANALYSIS OF VARIANCE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 3 | 710.3 | 236.8 | 20.77 |
| ERROR | 30 | 342.0 | 11.4 | |
| TOTAL | 33 | 1052.3 | | |

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                         BASED ON POOLED STDEV
LEVEL            N   MEAN  STDEV------+---------+---------+------
GF Deletes   9  16.63  2.95                (---*----)
w/BRF
CF Deletes   9  19.85  3.96                      (----*---)
w/BRF
GF Deletes   8  11.21  3.14       (---*----)
w/o BRF
CF Deletes   8   8.09  3.33(----*----)
w/o BRF
                              ------+---------+---------+------
POOLED STDEV = 3.376                 10.0      15.0      20.0
```

## APPENDIX F

## FFG-7 AND SSBN ISNSL DATA COMPARISON

TABLE 138
FFG-7 AND SSBN-726 CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE A FACTOR

| Hull | ISNSL | CF % Del | Hull | ISNSL | CF % Del | Hull | ISNSL | CF % Del |
|---|---|---|---|---|---|---|---|---|
| 41 | 3 | 23.647 | 50 | 2 | 21.867 | 727 | 2 | 14.914 |
| 42 | 3 | 23.157 | 51 | 2 | 15.234 | 727 | 5 | 22.208 |
| 43 | 2 | 22.750 | 52 | 3 | 22.489 | 729 | 2 | 14.271 |
| 43 | 4 | 26.918 | 53 | 2 | 24.022 | 730 | 3 | 12.731 |
| 45 | 3 | 22.056 | 54 | 3 | 24.181 | 731 | 3 | 11.638 |
| 46 | 2 | 24.971 | 55 | 3 | 19.964 | 733 | 2 | 83.825 |
| 46 | 4 | 18.639 | 56 | 3 | 17.297 | | | |
| 47 | 2 | 19.745 | 57 | 2 | 12.808 | | | |
| 47 | 4 | 19.231 | 58 | 2 | 20.108 | | | |
| 48 | 2 | 19.986 | | | | | | |
| 48 | 3 | 20.587 | | | | | | |
| 49 | 2 | 20.004 | | | | | | |
| 49 | 4 | 19.906 | | | | | | |

```
                .
                : .
              .:.:...
-------+---------+---------+---------+---------+---------
              3rd Flight FFG CF Deletes w/BRF

          .. .: ::
-------+---------+---------+---------+---------+---------
              4th Flight FFG CF Deletes w/BRF

     : :   .                                     .
-------+---------+---------+---------+---------+---------
     15.00     30.00     45.00     60.00     75.00
                 SSBN-726 CF Deletes w/BRF
```

Figure 67. FFG-7 vs SSBN-726 ISNSL Allowance Deletions Dotplot Annual BRF Update a Factor

TABLE 139
FFG-7 VS SSBN-726 CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE A FACTOR
ANALYSIS OF VARIANCE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 2 | 173 | 86 | 0.51 |
| ERROR | 25 | 4198 | 168 | |
| TOTAL | 27 | 4370 | | |

```
                                     INDIVIDUAL 95 PCT CI'S FOR MEAN
                                          BASED ON POOLED STDEV
LEVEL        N    MEAN   STDEV------+---------+---------+--------
3rd Flt   13   21.66    2.49      (---------*---------)
CF Deletes w/BRF
4th Flt    9   19.77    3.95  (----------*-----------)
CF Deletes w/BRF
SSBN-726   6   26.60   28.28      (-------------*--------------)
CF Deletes w/BRF
                              ------+---------+---------+--------
POOLED STDEV =   12.96             15.0      22.5      30.0
```

TABLE 140
FFG-7 AND SSBN-726 CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE NOT A FACTOR

| Hull | ISNSL | CF % Del | Hull | ISNSL | CF % Del | Hull | ISNSL | CF % Del |
|---|---|---|---|---|---|---|---|---|
| 40 | 4 | 9.554 | 50 | 3 | 5.364 | 727 | 3 | 9.511 |
| 41 | 4 | 9.067 | 51 | 3 | 14.534 | 727 | 4 | 4.262 |
| 42 | 4 | 6.853 | 52 | 2 | 5.201 | 727 | 6 | 6.866 |
| 43 | 3 | 7.527 | 54 | 2 | 10.984 | 729 | 3 | 4.816 |
| 45 | 2 | 8.918 | 55 | 2 | 7.300 | 730 | 2 | 19.029 |
| 45 | 4 | 11.078 | 56 | 2 | 9.110 | 731 | 2 | 8.451 |
| 46 | 3 | 12.238 | 57 | 3 | 7.301 | | | |
| 47 | 3 | 7.929 | 58 | 3 | 4.954 | | | |
| 48 | 3 | 16.373 | | | | | | |
| 49 | 3 | 10.427 | | | | | | |

```
              .  ..    :  .   .  .    .             .
+---------+---------+---------+---------+---------+-------
           3rd Flight FFG CF Deletes w/o BRF

       :.     :     .      .          .
+---------+---------+---------+---------+---------+-------
           4th Flight FFG CF Deletes w/o BRF

    . .       .    .   .                           .
+---------+---------+---------+---------+---------+-------
3.00      6.00      9.00      12.00     15.00     18.00
               SSBN-726 CF Deletes w/o BRF
```

Figure 68. FFG-7 vs SSBN-726 CF ISNSL Allowance Deletions Dotplot Annual BRF Update Not a Factor

TABLE 141
FFG-7 VS SSBN-726 CF ISNSL ALLOWANCE DELETIONS
ANNUAL BRF UPDATE NOT A FACTOR
ANALYSIS OF VARIANCE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| FACTOR | 2 | 16.6 | 8.3 | 0.59 |
| ERROR | 21 | 292.8 | 13.9 | |
| TOTAL | 23 | 309.4 | | |

```
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL       N   MEAN   STDEV  --+---------+---------+---------+--
3rd Flt    10   9.99   2.78             (------------*------------)
CF Deletes w/o BRF
4th Flt     8   8.09   3.33  (-------------*-------------)
CF Deletes w/o BRF
SSBN-726    6   8.82   5.39   (----------------*----------------)
CF Deletes w/o BRF
                              --+---------+---------+---------+--
POOLED STDEV =   3.734          6.0       8.0      10.0      12.0
```

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Thesis
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Excess outfitting materials in Ship Construction Navy (SCN) shipbuilding programs: an analysis of the initial allowance development process.